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# THE AMERICAN

MONTHLY

1471

# MICROSCOPICAL JOURNAL

EDITOR

ROMYN HITCHCOCK, F. R. M. S.

VOLUME V 1471



3508.0  
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20.

WASHINGTON

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# THE AMERICAN MONTHLY MICROSCOPICAL JOURNAL

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# THE AMERICAN MONTHLY MICROSCOPICAL JOURNAL.

VOL. V.

WASHINGTON, D. C., JANUARY, 1884.

No. 1.

## The Microscopical Study of the Crystallization of Allo- tropic Sulphur.

Not long ago, while melting some sulphur for the purpose of obtaining the flexible form of that substance suitable for taking impressions from a coin, I became interested in the phenomena observable on cooling the melted material, and watching the recrystallization under the microscope. Having shown these appearances to a number of friends, and found no one to whom it was not new, it seems worthy a description in the JOURNAL.

Next, perhaps, to phosphorus, sulphur is the most remarkable and interesting element in the allotropic forms it presents. Chemists and physicists describe at least six different allotropes of sulphur, but their study presents many difficulties, since only a few of them are as yet well identified and characterized. (Wurtz, in Johnson's Universal Cyclopædia.) Two of these forms are said to be crystalline, crystallizing in different systems, and being, therefore, dimorphs. These are—1, right rhombic octahedra, and 2, oblique rhombic prisms belonging to the monoclinic system. The description of the characteristics of the different forms may be found in the text-books, and the only one necessary to be referred to here is the singular product obtained by heating sulphur till it passes from a yellow fluid to the state of a brown viscid mass (at about  $230^{\circ}$  C.), and then suddenly cooling it by pouring it into cold water. Sulphur thus treated loses its prominent charac-

teristics, and remains for some time flexible, retaining its dark color, and may be moulded like wax, readily taking impressions like that substance.

Flowers of sulphur or roll-sulphur may be conveniently melted in a porcelain capsule, over a lamp or in a stove, until the brown color appears. It is then poured into cold water, and the mass again melted, and a few drops poured on a slide. It hardens rapidly, and must be kept liquid while a thick cover is pressed down upon it. Before it again congeals it is placed on the stage of the microscope, and examined with a power of 75 or 100 diameters. As it cools, beautiful masses of prismatic crystals start from the edges of the film, and spread over the field with a rapidity proportionate to the time occupied in cooling and the thickness of the film. With a thick cover, or with what is still better, a piece of a thin slide, for a cover-glass, cooling proceeds slowly enough to enable the forms of the crystals to be studied as they grow. The warm stage is also an advantage. They may be re-fused, and the same process observed an indefinite number of times, an endless variety of form and color being obtained by the different recrystallizations.

A Bunsen burner affords the most convenient means of heating the slide, but a spirit-lamp, German student-lamp, or a hot stove may be employed, care being taken to apply the heat gradually, and to distribute it by constantly moving the slide to avoid cracking. The odor of the melting sulphur is disagreeable to some persons, and care should be

taken not to inhale the fumes directly. The brass-work of the stage should be also guarded from contact with the melted sulphur. If the brass is accidentally discolored, however, a little ammonia on a cloth removes the black stains readily. The fumes alone exercise little influence on lacquered brass.

The study of these crystals as they form with mathematical regularity of outline, yet constantly modified by encroachment on one another, is one of the most fascinating occupations to a microscopist. Their appearance must be seen to be understood, as a verbal description entirely fails to convey an idea of their beauty. Long, straight lines shoot like an arrow into the surrounding fluid, throwing out laterally as they go countless subordinate prismatic crystals, or sometimes the main axes spread by vast numbers of delicate plates, with absolutely regular outline, a right-angled border generally presenting in the line of direction. These slide one over another, as the different strata are cooled, and finally leave the whole thickness of the film fixed in a dense crystalline mass, suggestive of a section of granite or porphyry.

When we remember that sulphur in its mineral form is itself a volcanic product, the analogy of the results produced by its hardening, after fusion, to the internal structure of igneous and metamorphic rocks is the more interesting. After remaining for several days on the slide the crystals often undergo spontaneous fracture, showing cleavage lines similar to those found on a great scale in the earth's crust, and here and there a vivid suggestion of basalt. This contraction sometimes produces concentric cracks immediately after cooling, when a high degree of heat has been applied, or after numerous regelations. These cracks have a remarkable symmetry of arrangement, and are first concentric and afterward followed by radial ones.

Returning to the first changes de-

scribed, the prismatic and plate-shaped crystals, by their junction with crystals from other centres of crystallization, form the most unique combinations imaginable. The long, straight lines produced by the axes of the different crystalline masses are often so connected by lateral lines as to convey a striking likeness to rude architectural forms and sculptured ornaments. When the film is thick the crystals rush together at various angles like opposing lines of bayonets, and by their blending form an apparently homogeneous mass which flows like lava across the field, its advancing edge showing numberless wave-like wrinkles. When two such masses meet at an angle they join and advance together, leaving the line of their union clearly marked out by a straight line, such as often appears in intersecting veins of agate. Sometimes crystals start from independent centres in the fluid, producing rosette-shaped masses of much beauty.

It should be observed that while the phenomena described above are the rule, it occasionally happens that after the first melting a very rapid congelation takes place, leaving a nearly structureless appearance of the whole field. All that is then necessary is to rewarm the slide and press the cover lightly, when the crystals will appear as here described.

Under the polariscope a thin film of sulphur in its allotropic state often shows very rich prismatic colors, and the mineral therefore deserves a place in the first rank of polariscope objects, though not included in the very full list given in the latest edition of Carpenter.

A brilliant red or green local color is sometimes noticed also in the crystals when modified by heat. Too much heat forms black crystals and numerous bubbles, obscuring the further study of the crystallization.

In the study of this singular substance not the least interesting feature is the behavior of the microscopist's old friend, the air-bubble. When a



thin film is slowly cooling, and not yet wholly crystallized, the contraction sometimes draws in a bubble of air from the edge of the cover. Entering the still fluid mass, the air makes its way directly to the centre of the region unoccupied by crystals; but, as it lowers the temperature by its intrusion, the fluid cannot surround it, but a tube of solid sulphur seems to form around it as it advances, leaving a central cavity surrounded by a wall exhibiting fine lines of perpendicular striation, like the dentine around a tooth pulp-cavity. Vacuoles often arise in the central part of the fluid, and enlarge in a similar manner, but without the surrounding wall. Precisely similar vacuoles may be met with in many crystalline rocks.

Bisulphide of carbon, boiling oil of turpentine, and some other solvents of sulphur deposit both octahedra and prisms of sulphur from solutions, and a combination of allotropic sulphur and paraffine produces certain modifications of its crystalline structure; but the most remarkable change I have yet noticed was produced by melting yellow sulphur in a mounting fluid composed of hard balsam dissolved in absolute alcohol, with a trace of benzole. On stirring the mass it soon became clouded, and under the lens showed clear spaces, intermingled with semi-opaque spots, which show under the  $\frac{1}{4}$ -inch vast numbers of minute spherules of sulphur and some large ones. These molecules in mass showed violet, blue, red, and other colors by transmitted white light. Believing this color to be due to some kind of polarity in the molecules, I set the preparation aside to await developments. It was examined from time to time, and after the lapse of about a month large ramifying crystals of prismatic sulphur were found to have formed of a pale yellow color, and each surrounded by a clear space bordered by the same fine molecules, which seemed to have been absorbed to form the crystals. The subject of crystalliza-

tion of inorganic matter in colloid substances is one fraught with interest to the student of organic structures, and a study of this form of crystallization may shed some light on such processes.

EDW'D M. SCHAEFFER, M. D.

WASHINGTON, Jan. 1st, 1884.

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### A New Slide and Slide-Box.

Messrs. J. W. Queen & Co. have recently introduced a modified form of the concave slide, for which some advantages are claimed. It is represented in Fig. 1, and it will be seen

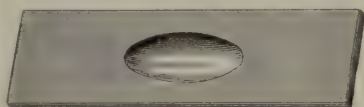


FIG. 1.

that it differs from the old form in that the concavity is oval instead of round.

The new box for holding slides is also a modification of, and an improvement upon, the form they have been selling for some time. The new form is illustrated in Fig. 2. It is

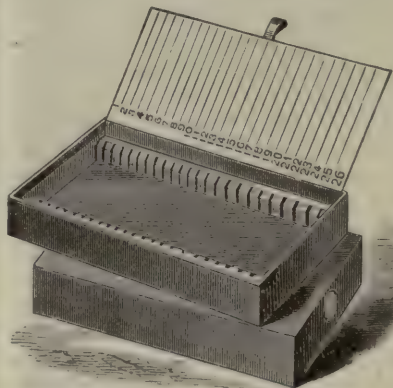


FIG. 2.

very substantially made, and has a neat appearance.

Each box holds twenty-six slides, and on the inside of the cover the name of each object may be written on a line corresponding to the position of the slide. As will be seen

from the cut, the slide-box proper is held in an outer case, which not only affords additional strength, but also effectually excludes dust.

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## An Infusorian in the Water of San Francisco.

BY A. H. BRECKENFELD.

A beautiful and exceedingly interesting infusorian is to be found at present in the water supply of this city in such immense numbers as to entitle it to a more than ordinary share of attention and study. It has recently been briefly described by Dr. Hopkins, a microscopist of this city, but I think the gentleman has fallen into a quite natural error in regard to it. He regards it as a vegetable organism, and has classed it with the Diatomaceæ, considering it a species of *Syringidium* (Ehr.), which is, by the way, a marine genus, with no freshwater species! The appearance of the form in question would very easily lead an observer to consider it a diatom, for its rigid lorica is hard and flinty looking, and its markings strongly resemble those of certain diatoms—for instance, those of the genus *Isthmia*. Then, too, the slow and hesitating movement of some of the living individuals is often very much like that of the free diatoms. The Diatomaceæ, however, without exception, secrete a siliceous shell or epiderm (this being in fact one of the principal characteristics of the group), and either subjection to a white heat, or boiling in nitric acid will merely dissolve the contained endochrome, leaving the frustule itself clean and entirely uninjured. But on applying these tests to the form alluded to it is completely destroyed, and with it its claim to be considered a diatom. It will have to be referred, I think, to the genus *Ceratium* (Shrank.) belonging to the order Peridinina of the Cilio-flagellate Infusoria, and is very probably *Ceratium longicorne*.

A sketch of this particular species

can be seen in No. 3 of the "Portfolio of Drawings," published by T. Bolton, England, and agrees almost perfectly with the appearance of the *Ceratium* found in "Spring Valley," but shows a flagellum between two of the shorter spines. Carpenter in his work, "The Microscope," also gives an engraving of two other species of *Ceratium* each showing a flagellum. I must confess that, although using an excellent Spencer one-quarter-inch objective (dry) of 115° angle, and a C ocular, I have not yet been able to demonstrate the existence of either a flagellum or of cilia. In attempting to render them visible I have tried the effect of both tannic and osmic acids, and also of other reagents and staining fluids, but thus far without success. This may, perhaps, be accounted for by the theory that these creatures may now have passed into the "still" condition, and the rapidity with which they subside to the bottom of the water containing them—forming a dense layer there—lends some plausibility, I think, to this view.

The characteristics of the genus are: "Body with transverse groove, the two portions of the faceted lorica nearly equal. Carapace has horn-like processes." This description applies perfectly to the infusorian under consideration. The micrometer shows its average length to be about .0085 inch and its width .0025 inch. The horn-like processes are slightly serrated, or spinous, the three shorter ones on one hemisphere being sharply pointed, while the long one projecting from the other is blunt at the end. They have no joints, are perfectly rigid, and the entire lorica has a glassy appearance, and, when properly illuminated, sparkles as brilliantly as a polycystine. From the equatorial groove to the base of one of the three spines is quite a deep depression (best seen in an empty carapace), into which several European observers of this form have seen the flagellum suddenly withdrawn. This depression has been conjectured to be a true



mouth, although Carpenter seems inclined to think that the individuals of this group have no mouths, admitting, however, that "it seems certain that alimentary particles are received into the interior of the body, becoming enclosed in digestive vesicles." The same distinguished authority intimates that the transverse furrow, or groove, is ciliated and that the flagellum originates at a point near the junction of the depression before alluded to with the furrow. He further calls attention to the interesting fact that the group to which *Ceratum* belongs "is specially worthy of notice on account of the occasional appearance of some of its forms in extraordinary numbers." He cites an instance when the water of one of the large ponds in Phoenix Park, Dublin, was colored brown by the presence of immense swarms of a genus closely allied to *Ceratum*. Any possessor of a microscope in this city can verify the existence of this peculiarity in the order by tying a piece of linen or muslin to a faucet (connected directly with the street pressure) in such a way as to act as a filter, turning on the water with moderate pressure for ten or fifteen minutes, and examining the brownish coating deposited on the cloth. It will be found to consist of thousands of these organisms, to the exclusion almost of other forms. Filterings taken from the Western Addition, the Mission, Taylor street, and Sansome street, all show it in prodigious numbers, so I presume the water supply in any part of the city will yield it. The brownish, flocculent looking sediment which many must have seen on the bottom of pitchers or glasses containing unfiltered "Spring Valley" is almost entirely composed of the animal.

The empty carapaces are quite transparent, but the living forms secrete a brownish granular matter in the body itself or closely adherent to it, and many appear to have attached to them, between the shorter horns or spines, an exceedingly transparent

globule or sac, which, if watched very attentively, will frequently show a sort of amœboid movement, and which is more or less completely filled with protoplasm, wherein are included numerous highly refractive globules, together with the "red eye," seen by Dr. Hopkins. This red granule is considered by Carpenter to be analogous to similar spots frequently found in Protophytes, and is probably a nucleated cell.

In order to obtain living forms, showing the curious movement before referred to, some care is necessary. I have found it best to gently rinse the brown deposit formed on the cloth filter into a very little water, and examine with as little delay as possible. An aqueous solution of tannic acid seems to render the outline of the hyaline sac or globule more visible, but apparently kills the animal. By using an ammoniated solution of carmine it will be found that the protoplasm is strongly stained, while the carapace itself is entirely unaffected.

For those having the necessary leisure and equipment there is room for very interesting research into the life-history of these remarkable organisms, whose presence in our water supply in such incalculable numbers renders such observation more than ordinarily important, for the question of whether the wholesomeness of the water is impaired by their presence is certainly well worth investigating.

[The species of *Ceratum* described by Mr. Breckenfeld is also quite common in the water supplied to other cities. We have seen it at various places—in New York in considerable abundance—but nowhere has it occurred in our collections in such quantities as is indicated by a mounted slide sent by Mr. Breckenfeld. We have frequently observed the cilia in living specimens.—Ed.]

#### **Oidium Tuckeri—A Fungus of the Grape-Vine.**

At a recent meeting of the Biological Society of Washington, Dr.

Thomas Taylor, Microscopist of the Department of Agriculture, read a paper relating to the morphology of the fungus known to botanists as *Oidium Tuckeri*. He said: This fungus was first observed in England as a mildew on the foliage of the European grape-vine by a gardener named Tucker, but its form and place in botany was first made known by the Rev. M. J. Berkeley, of England. The vineyards of France were soon after invaded by this fungus; from thence the spores were distributed over Europe, destroying the vintage for a term of years and causing serious financial disaster to those engaged in grape culture.

At an early period of its history it was observed by Mr. Berkeley that the *Oidium*-form was but one of the stages of the fruiting of this fungus, and that its higher form of fruit was probably an erysiphoid, but up to this date, 1883, no erysiphoid has been found on the vines of Europe, although it is stated that a form of fruit named pycnidia has been observed growing on the same mycelium with the *Oidium*, and fashioned somewhat in its outward shape like the *Oidium* but differing from it in bearing ovules and sporidia. The mildew, as seen on the foliage, consists of very minute, interlacing, white threads, felted, jointed, and branched, from which arise pedicels or stalks, on which are borne a series of oblong spores joined end to end. The latter constitute the *Oidium*. For many years past, and prior to the discovery of the vine-*Oidium* of Europe, a similar *Oidium* bearing an erysiphoid form of fruit was observed on the native vines of this country, and has been described at various times by Curtis, Howe, Peck, Farlow, Berkeley, Cooke, and others as an *Uncinula spiralis*. In the year 1870 I first observed, on the foliage of several native species of vines growing on the grounds of the Department of Agriculture, not only the *Oidium*-form, but also the higher fruit *Uncinula spiralis*. I have not,

thus far, observed pycnidia associated with the so-called *Oidium* or grape-vine disease of this country. During the summer of 1870 I made an investigation of a mildew observed on the foliage of the foreign vines cultivated in the hot-house of the Department of Agriculture, and found it to consist of mycelium (spawn), bearing conidial spores. On comparing this mildew and its *Oidium* spores with the drawings of the vine-*Oidium* described by Mr. Berkeley, I found the two to be identical in structure. In the fall of the same year I discovered also on the foliage of these vines (one hundred varieties in all) little dark specks hardly perceptible to the naked eye, but in great profusion. By the aid of the microscope their true character was at once discovered. One seemed to me to be an *Erysiphe*, the other a species of *Uncinula spiralis*, the latter resembling the highest stage of fruit found on the American vines. Subsequent observations, however, demonstrated that the two forms observed, belong to *Uncinula spiralis*, although it is plain that the cell-structure of the appendages of the two forms seen, differ very much from each other, and this, too, when it is evident that both specimens are equally matured. In this matter further investigation is needed.

In the year 1871 the same vines were again affected with this fungus, but since then the higher fruit, *Uncinula spiralis*, has not appeared on these vines until this year (1883), although I have carefully watched for it each year. The *Oidium* stage has been seen more or less every year on these vines since 1871. During the early part of November of this year I observed that these vines were again covered, as in 1870 and 1871, with the perithecia of *Uncinula spiralis*, specimens of which have been forwarded to several of the leading micrologists of America; specimens were also sent to Cooke and Berkeley of England. The last-named gentleman has taken marked interest in the



subject, and considering the fact that Mr. Berkeley is one of the leading cryptogamist of Europe, his prompt reply to my letter and the interest he manifests in the subject is pleasing. Mr. Berkeley states in reply that no one has seen the perithecium of *Oidium* in Europe, and further that he is not aware that any one has seen the perithecium as discovered by me on the foreign vines of this country. Dr. Taylor stated that he deemed it highly probable that the *Oidium* spores of the native American vines had been wafted to England from this country, and were the real parent stock of *Oidium Tuckeri*, but he thinks that the climatic conditions of Europe are unfavorable to the development of its higher form of fruit. He further thinks it probable that the *Oidium* he has discovered on the foreign vines cultivated under glass in this country are also of American origin and give rise to *Uncinula spiralis*—Berk. and Curtis. If this view is correct, the perithecia he has discovered on the foreign vines represent in reality the perithecia of *Oidium Tuckeri* of this country and of Europe.

Dr. Taylor read the following letter published in the *Gardeners' Chronicle* from the pen of that great Apostle of Cryptogamic literature, Miles Joseph Berkeley, of England, relating to the subject:—

“The following very interesting communication has been received from Dr. Taylor, of the Department of Agriculture, Washington, dated October 28th:—This summer and at this moment 100 foreign grape-vines of 100 varieties are, so to say, covered with the perithecia of an erysiphoid fungus of which I enclose specimens. I am fully aware that many of the American varieties and some of the species have the form *Uncinula* on them, but I am not aware that any one has ever found any form, subgenus, or species of this character on the foreign grape-vines. You are, I suppose, aware that in North America the foreign grape-vine is grown

wholly under glass structures, California excepted. The *Oidium Tuckeri* is quite common on the foreign vine. Within twelve years our foreign vines were affected alike. I have watched each year since 1871, but no perithecia were seen.’ On examination of the specimens we find the *Uncinula*, as far as we can see, to be identical with *U. spiralis*, Berk. and Curtis, having the same long appendages, the tips of which are distinctly spiral tips and not merely hooked. This species was sent to us by Mr. Curtis on leaves of *Vitis labrusca*. As far as we are aware, like Dr. Taylor, no perithecium has ever been developed on European vines on which the *Oidium* is so common and destructive. Pycnidia have been found by Amici, but no perithecia. It is, therefore, certainly curious that perithecia should have developed in America under glass, and still more so that it should be a specimen which occurs on the well-known *Vitis labrusca*. As that *Uncinula* is not known in Europe we cannot suppose that it arises from the historical *Oidium Tuckeri*. With the vine leaves there was a leaf of some American *Vitis* thickly clothed with *Capnodium elongatum*, Berk. and Desm. It should be mentioned that I found on the same leaf with the *Uncinula* a single perithecium, in an imperfect state, of some *Phyllactinia*.”

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### Testing a Microscope.

A few practical hints about examining a new stand to find out its defects may be of service, not only to novices in the work, but to many who have had experience in the use of the instrument. It is not intended to go thoroughly into the subject, but only to allude to several details concerning which it might puzzle some persons to decide.

*To test the centering of objectives.*—The best way to do this is to put a small object in the field, such as

a small scale of an insect, or a diatom, and secure it in position on the stage. Then place the point of the indicator\* of the eye-piece upon the object. Every objective should show the indicator-point upon the object if they all centre accurately. The most that can be expected is a reasonable approach to accuracy in this respect. The limit of variation permissible we cannot definitely state.

There is an opportunity offered here for some microscopist to do a good service for his collaborators. It would be of considerable interest to know what are the variations in the centering of objectives. Those of each maker should be compared among themselves and with those of other makers. The way to do this is to place a micrometer scale in the ocular, and measure the change of position of the object with reference to the end of the indicator. The work requires care and patience, but it is worth doing, and is of special importance in testing the new forms of nose-pieces now coming into use.

*To test the binocular.*—This is by no means an easy matter for the novice, since it requires some experience to know when the best appearance of relief is obtained. Nevertheless, a little practice will enable any person with good eyes to determine whether the images in the two fields blend well together, if these instructions are followed.

It is possible to acquire the ability to see the two images independently with the two eyes, and thus compare them side by side, and then cause them to come together, when, if they do not blend, the fault will be at once detected. This, however, is not readily done at first trial. To test the blending, therefore, proceed thus: Get as perfect illumination in both tubes as possible. Take a well-defined opaque object, such as a shell of a polycystine, and throw a strong

light upon it. Focus it carefully, and note if the images in both tubes are equally distinct. Probably it will be found that the right-hand tube gives the brightest, and on the whole the clearest, image, but the difference should be very slight. Now draw out the binocular prism, and, while looking into both tubes, slowly push it in. If the light is properly adjusted, which is assured by having a distinct white object on a black ground, the image of the object will soon come into view in the left-hand tube, and by carefully repeating the experiment several times it will be a comparatively easy matter to decide whether the image corresponds exactly in position to the one in the other tube. If it does not, one will seem to overlap the other or to be quite independent of it, in which case the binocular is obviously imperfect.

Another plan is to select a slide of polycystina or diatoms arranged around a central specimen, which will quite fill the field, or a trifle more. Then examine the margin of both fields, and see if the same forms occupy the same positions in the two fields. Thus, suppose in the right-hand field a specimen just touches the margin in one place. Look at the same form in the other field, and see that it occupies the same position. If not, the arrangement is imperfect.

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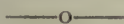
### A Simple Eye-Piece Indicator.

The indicator is a very useful, but not very common, attachment to an ocular. When showing objects to friends they are very apt to devote their energies to the admiration of pieces of dirt—just what we do not want them to see—rather than to the beautiful, but perhaps very transparent and less distinctly visible, object. At other times, when there are many objects in one field, it is often quite difficult to designate any particular one. This difficulty is very easily removed by the use of an indicator, the point of which is made to indicate the object.

\* An indicator for an eye-piece can be made very quickly in the manner described in the succeeding article.



A very simple and in all respects satisfactory indicator is made by attaching a hair to the diaphragm of an ocular, so that it will extend half way across the field of view. This is easily done by selecting a small bit of paper, placing a little gum upon it, and laying a hair across it, the pointed end of the hair extending just far enough beyond the paper. When dry cut the paper to a proper size and moisten the gummed side. Then place it in position on the diaphragm of the ocular, let it dry, and the apparatus is ready for use. This simple arrangement is entirely satisfactory, and we have it now in constant use. The hair is not objectionable in the ocular, as it appears like a fine, sharp line, and is quite overlooked when one gets accustomed to its presence.



### The Improved "Biological" Stand.

Mr. Bulloch has made further improvements on his "biological" microscope that deserve complimentary notice. The principal improvement relates to the substage, which at first did not impress us favorably, but having since found opportunity to test it practically, we would give it unqualified commendation.

The substage and mirror-bars move independently, with the object as a centre, as heretofore, but immediately beneath the stage, just above where the rack-work ends, the substage-bar is cut transversely and the two parts joined together by a pinion and screw passing vertically through lateral projections cast for the purpose. About this pin the lower part, carrying the substage with its rack and centering screws, swings laterally, entirely out from beneath the stage. The space between stage and mirror is thus entirely clear, and this is a much better plan than the one adopted by some English makers, who remove the substage entirely, which we have spoken highly of in a previous article. For not only is the space before mentioned

unobstructed by the substage, but the substage itself is practically clear of the microscope, where it can be seen and apparatus removed from it or added to it with even more facility than if it were held in the hand.

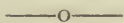
We are not aware that this plan of removing the substage has ever been applied to a microscope before. If not, Mr. Bulloch deserves great praise for it. He has not said one word about it to us, and it may be that he is not himself fully aware of the great convenience of the device to the working microscopist. We regard it as the greatest improvement in substage fitting that has been made in years, and one that is sure to be appreciated as its value becomes known.

The substage ring is also made in two parts, and the lower part swings to one side independently. This part may carry a tinted glass to modify the light, or the diaphragms of a condenser, which could be conveniently changed. We would suggest, however, that it would be better to place the condenser and its diaphragms in the upper substage-ring, while the polarizer with its plates of mica and selenite are fitted in the lower ring. Such an arrangement would give the microscopist every facility for work that could be desired. Without removing a single accessory he would be prepared to use the light directly from the mirror, by turning the substage aside. Then the condenser could be brought into use by a single motion, and the different effects of oblique light and dark-ground illumination obtained by the simplest possible operation of changing diaphragms. Then by throwing in the polarizer, which is always ready for use, all the effects of polarized light—which are almost inexhaustible—can be obtained.

With this substage even a better system of substage illumination is possible than is afforded by Swift's condenser, which we have already so highly commended. It only remains to properly arrange the illuminating

apparatus, which we hope Mr. Bulloch will soon do.

The stand is also provided with Mr. Bulloch's new detaching nose-piece, which has already been mentioned in these columns.



### Robert B. Tolles.

The death of Mr. Robert B. Tolles was briefly announced in the December number. The Boston *Herald* of Nov. 20th contained the following brief summary of Mr. Tolles' business career:—

“Mr. Robert B. Tolles, of the Boston optical works, who died at the Massachusetts General Hospital on the 17th instant, had a world-wide reputation as a maker of microscopes, and particularly as a maker of microscope objectives, such as are required by and used in the highest class of scientific work. He also contributed as much, if not more than any other optician, toward developing that instrument and bringing it to its present high state of perfection.

“Mr. Tolles was born in Connecticut 62 years ago, but at an early age went to New-York, where, while yet a young man, he entered the employ of the firm since widely known as Spencer & Son, optical instrument makers. With the senior member of that firm, Mr. Charles A. Spencer, then at Canastota, he learned the business of grinding lenses and the mechanical construction of microscopes and telescopes. After being with Mr. Spencer a number of years, he set up for himself in the same line of business in the same town. He remained there until 1866, when he came to Boston, and, in connection with Mr. Charles Stodder, founded the Boston optical works, which business connection continued until his death; and it was here that most of his reputation as a maker of first-class objectives for the microscope was achieved. He was among the first to produce what are known as wide-angle objectives, and to demonstrate

their superiority in showing the finer details of the structure of objects. Although not the discoverer of immersion objectives, he at once recognized their great value, and was among the first to manufacture them. Mr. Tolles was the inventor of many valuable accessories, both of the microscope and telescope, but, undoubtedly, his greatest achievement in this direction was his demonstration of the practicability of the homogeneous immersion objective and its superiority over other lenses. This he demonstrated in 1871, but owing to the fact that at that time Canada balsam was the only fluid known to possess the same refractive index as crown glass, his discovery remained useless until 1877, when Prof. Abbe discovered a fluid which was practical for such a purpose. Since then a large number of such objectives have been made and numerous discoveries made by their use, which would have been impossible with the old water-immersion lenses.

“Mr. Tolles was a very quiet, unassuming gentleman, who devoted his whole life to his work. He had not been in health for a long period of time, having been a sufferer from a chronic lung disease which most persons would have succumbed to years before. In his death the scientific world has sustained a great loss.”

The following letter from a well-known microscopist of Boston will doubtless be more highly valued by our readers than would a more elaborate and formal account of the life and services of Mr. Tolles, for, coming as it does from one who knew him intimately, and embodying such personal recollections as can only come from long association, they reveal more of his characteristics than could the more high-sounding praises of a stranger:—

It is with pleasure that I comply with your request to write a few words in memory of Mr. R. B. Tolles, whose death is a great loss to all microscopists.



I first met Mr. Tolles about the year 1870, and was so impressed with his intelligence, his modesty and gentlemanly bearing, that it was always after a pleasure to meet him. He was very ingenious, very skilful with hand and eye, and always willing to aid in designing and arranging devices for the microscope. Of course he is best known for his skill in making high-power objectives, but with greater facilities he might have been as famous in other departments of optical work.

After making the objectives which Dr. Woodward made famous by his photographs (August, 1872), Mr. Tolles made no decided improvement for some time. In fact, the water-immersion system had about reached its limits. Before this, however, he had constructed objectives which he claimed had a balsam angle, but this claim was not generally recognized for some years. After the use of immersion fluids of a higher refractive index than water became known, Mr. Tolles made a decided advance in the quality of his objectives. I have examined many of his homogeneous immersion objectives, and compared them with my Zeiss  $\frac{1}{8}$  (a duplicate of the one described by Dr. Woodward *Journal R. M. S.*, p. 663), and while all could well bear the comparison, most were fully equal to the Zeiss.

But your space will not permit an extended review of Mr. Tolles's work. I will, therefore, refer to an incident which had an important effect in facilitating the testing of his balsam angle objectives. In the spring of 1875 he passed an evening with me, not knowing what was to be shown him. Before he arrived I arranged my microscope horizontally, having on the stage a Probe Platte, illuminated with Wenham's reflex illuminator. The objective was a water-immersion  $\frac{1}{10}$ , made by himself. The light (a kerosene lamp) was placed axially and the resolution of *Amphipleura* was accomplished from end to end of the frus-

tule. I threw a cloth over the objective and illuminating apparatus. On looking through the microscope he saw at once the resolution and was greatly astonished on learning that the amphipleura was on a Probe Platte and in balsam. He had never seen a resolution of a balsam-mounted amphipleura by lamp-light. (I believe it had never been seen until a short time before when I first observed the capabilities of the reflex illuminator.) After his first astonishment he became very grave and silent. He afterwards told me that he supposed I had obtained some wonderful objective surpassing anything he had seen, and the thought that an objective had been made, unknown to him, and superior to any of his own, was very disappointing. But notwithstanding this feeling, which must have been very depressing to his sensitive nature, he asked no question, but waited patiently until this superior objective should be uncovered. It did not once occur to him that the secret lay in the illumination, and when the cloth was removed and he saw that he had been looking through a  $\frac{1}{10}$  of his own, the change that took place in his face was remarkable; his pleasure and satisfaction were very great, and he again became cheerful and chatty. He immediately appreciated the operation of the reflex illuminator, and began the next day to make copies with different angles for his own use. This gave him positive tests for his balsam angle objectives, such as he had not before possessed, and saved much time in constructing objectives.

Mr. Tolles's reputation in telescopic work was not so extensive as in microscopy, but it deserves mention. His introduction of short focus object glasses for telescopes was a great improvement. He made these glasses from  $\frac{1}{8}$ -inch to 7 inches in diameter, and it is unfortunate that he did not have an opportunity to construct some larger lenses. The  $2\frac{1}{2}$ -inch glass was a great favorite; its definition was

beautiful, and the shortness of focus gave it a steadiness and convenience in use that the merest tyro could appreciate. The few possessors of the  $\frac{1}{2}$ -inch pocket glasses esteem them beyond prize.

SAMUEL WELLS.

After a life of constant activity and conscientious devotion to his work, Mr. Tolles has left behind him nothing but well-earned fame. His memory will live fresh in the thoughts of all who knew him, and after the present generation has passed away there will still be the results of his earnest, thoughtful life to make his fame endure. His has been a life worth living, and we trust his reward is great.

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### Expanding the Blow Fly's Tongue.

If the head of a living fly be cut off the tongue will usually retract; pressure on the head will expand the tongue, but unless it be secured by some means before the pressure on the head is released it is apt to wholly or partly retract again. If only the tip is wanted, it is easily secured by placing the severed head on a clean slip and pressing it with a needle till the tongue is fully expanded, when a drop of turpentine is applied, a cover laid on the tongue, and a clip applied before the pressure is removed from the tongue. To secure the whole tongue, split one end of a small stick for an inch or so, and holding the split open by a knife-blade, place the severed head in the cleft with the top downward, and, withdrawing the knife-blade, allow the stick to close upon the head, when it will fully distend the tongue. Now dip the head and tongue in turpentine and leave it immersed for a few days, when it will be found well cleaned, still perfectly distended, and can be released from the stick or cut from the head without danger of its collapsing. Mounted in a cell in balsam it is a truly beautiful object.

C. M. VORCE.

## EDITORIAL.

**PUBLISHER'S NOTICES.**—All communications, remittances, exchanges, etc., should be addressed to the Editor, P. O. Box 630, Washington, D. C.

Remittances should be made by postal notes, money orders, or by money sent in registered letters. Drafts should be made payable in Washington, New York, Boston, or Philadelphia.

Subscription-price before April 1st, \$1 per year, in advance. All subscriptions begin with the January number. After April 1st the subscription-price will be \$1.50.

The regular receipt of the JOURNAL will be an acknowledgment of payment.

**SPECIAL NOTICE.**—Attention is particularly called to the conditions of subscription for the current year, which, as already announced, must be paid in advance. Also to the change in price after the 1st of April from \$1 to \$1.50. We trust that none of our former subscribers will defer payment and then complain that they do not, as heretofore, receive the JOURNAL. Having established a rule it must act impartially, and in opening the new subscription-book no names will be entered until payment is made. This number is sent to former subscribers who have not yet paid, as a specimen number.

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**THE JOURNAL FOR THE YEAR.**—During the year a series of articles will be published, the first of which will appear in the February number, on Microscopical Technic, which will doubtless be of no little value to many readers. They will embrace full instructions for preparing and mounting specimens of all kinds, directions for using the microscope in ordinary work and also for purposes of exhibition and display, an explanation of the more useful accessories and the methods of using them, together with many hints useful not only to the beginner, but also to others. These articles taken together will almost constitute a text-book on the microscope. While elementary they will be concise, and the Editor will personally vouch for the reliability of every method described. They will not be compilations, but the result of individual experience.



As these articles are intended to assist the younger or less experienced workers with the microscope, the Editor would be pleased to receive requests for information relating to mounting or manipulation from any readers who may desire it. Replies will be embodied in the articles in their proper place, and will no doubt enhance the value of the latter. The sequence of the articles on preparing and mounting objects will be as follows:—

- I. The Apparatus and Materials required for mounting.
- II. General discussion of the different kinds of Mounting—Effects of mounting media.
- III. Mounting Dry.
- IV. Mounting in Balsam.
- V. Mounting in Fluid.
- VI. Mounting in Special Media.
- VII. The Cutting of Thin Sections.
- VIII. The Grinding of Thin Sections.
- IX. Coloring, Staining, Double Staining.
- X. Capture, Killing, and Preservation of Minute Organisms.

Other articles will be interpolated in the series, as they are prepared, so that there will be ample opportunity to cover an extended field under the general topic Microscopical Technic.

Articles from numerous correspondents have been promised or already offered for publication, and if we may judge from present prospects there will be no dearth of interesting matter this year.

The removal of the office of publication to Washington cannot but prove beneficial. Washington is one of the great centres of scientific work in the country. It offers facilities for original research, at least in some directions, superior to what can be found in any other city. The vast collections in the Smithsonian Institution and National Museum are always available for inspection and critical study. The Department of Agriculture affords an inexhaustible source of material for the botanist and entomologist; the Army Medi-

cal Museum contains numerous and valuable specimens and a justly celebrated library. The Library of Congress, which now includes the library of the Smithsonian Institution, is also of great value.

The opportunities for research, the fine collections, and the comprehensive libraries, have drawn many scientific students to this city, where much original and valuable work is constantly being done.

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#### IMPORTANT BUSINESS CHANGE.—

Mr. W. H. Walmsley, for six years the business manager for Messrs. R. & J. Beck, in Philadelphia, has issued a circular, dated January 1st, in which he informs the public that the American branch of the Messrs. Beck's business has been purchased by the new firm of W. H. Walmsley & Co., and will hereafter be conducted by the new firm at the same place as heretofore.

Messrs. W. H. Walmsley & Co. possess the sole and exclusive agency for all the manufactures of Messrs. R. & J. Beck in the United States, but orders for instruments of all makers will hereafter receive prompt attention.

Mr. Walmsley promises his personal attention to all orders, as heretofore; and, having ample capital invested, he asks for the new firm a continuance of the liberal patronage hitherto enjoyed by himself.

The members of the new firm are W. H. Walmsley, Isaac Collins, and Morris Earle. The address of the new firm can always be found in our advertising pages.

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#### CUTTING SECTIONS OF HAIRS.—

It is a matter of no little difficulty to obtain perfect, thin sections of hair, as many skilful operators can testify. The following method, which is described by Dr. P. Latteux, in his "Manuel de Technique Microscopique," seems to remove many of the difficulties ordinarily met with:—

It should be borne in mind that it

is important to have the sections as true as possible across the length of the hair, since an oblique section gives an oval outline, which might be misleading. To insure the hairs all being straight and parallel, a little wax is placed on one end of a glass slip, and the hairs inserted vertically in it, singly, by making holes in the wax with a warm needle. A small piece of diachylon plaster is then placed on the other end of the slide and made to adhere by pressure. Upon the plaster a piece of wax is placed, and the hairs are one by one attached to the wax by their free ends, being laid parallel. To hold them in place they are then coated with collodion by spreading a layer of that material between the two points where the wax is placed. Several coats should be applied, until the film of collodion is about 1 mm. thick. If the hairs relax during the process they may be straightened by moving the strip of diachylon plaster.

To cut the sections the strip of collodion may be cut up into small squares, each of which may be secured in a microtome between pieces of elder-pith, soft wood, or cork. The author has been able to observe torsion in the hair of a negro, by cutting a series of sections.

The hairs are mounted in glycerin or balsam without removing the collodion which holds the sections together. If balsam is used, oil of cloves must not be applied, as it would dissolve the film of collodion.

This ingenious method seems to offer an easy means of obtaining good sections of hairs, and offers an opportunity for some microscopist to contribute useful information concerning the form and internal structure of different varieties of hair.

In this connection it may be said that good results may be obtained in double-staining sections of hair follicles, if the proper method be followed. Picro-carmin and anilin violet give good results. The violet

goes to the outer layer of the inner root-sheath (Henle's layer), while the outer root-sheath and Huxley's layer take up the picro-carmin.

—O—

ILLUSTRATIONS FOR THE JOURNAL.—The editor is at present engaged in experimenting with a process of copying drawings which he hopes will materially reduce the cost of illustrations for the JOURNAL and at the same time yield excellent results—better, it is believed, than are furnished by the ordinary processes of photo-engraving. If these experiments prove as successful as they now promise to be, it will enable us to provide such illustrations of microscopic objects as only the excessive cost of engravings has prevented us from giving heretofore. A good illustration is equal to a page of description, and if we can succeed in the efforts now being made, our readers will soon appreciate the benefits thereof. If possible we will have the first illustration by the process referred to in our next issue, when readers may judge of the capabilities of the process.

The plan we propose to follow is to illustrate, so far as possible, the more common forms of minute plant and animal life, giving popular descriptions of the species, which shall be, at the same time, sufficiently accurate and full to enable the reader to compare the different species that may be observed with the typical forms illustrated. Such a plan carried out through successive numbers of the JOURNAL, cannot fail to be of great value to all microscopists.

—O—

MICROSCOPIC EVIDENCE OF THE ANTIQUITY OF ARTICLES OF STONE.—In the course of the trial arising out of the disgraceful quarrel in New-York, concerning the Di Cesnola collection at the Metropolitan Museum, the microscope has furnished evidence of the antiquity of certain articles. Mr. Benjamin Braman, President of the New-York Microscopical



Society, gave the following testimony, which is copied from the *Times* of Dec. 22d. Mr. Braman said:—

“I have used the microscope for thirty years. I have studied the general subject of rock surfaces. Dr. Barnard asked me last spring if I would undertake the microscopic examination of the surfaces of the statues in the Cesnola collection. I spent two hours a day in examining them during April and May; I spent a week during the summer and about five hours a day since October 10th last. I am able to distinguish between a surface freshly cut and a surface that has been corroded by burial.

“The Cypriote stone whereof these statues are sculptured is a cellular, calcareous tufa. The cells are minute and crowded. There are about 1,500 to the square inch. They are spherical in shape, and about 1-100 of an inch in diameter. When freshly cut, it will be found that the walls of some cells are harder than the walls of others. The hard walls resist the effect of the atmosphere with more success than the softer ones. During exposure these soft spaces sink first, and leave the hard ones standing like craters on the face of the moon. The soft spaces sink into dome-like shapes, and small orifices indicate that the atmosphere has begun to affect them. Then the cups thus formed are carried away, the hard projections roll off in small globes, and the process recommences. Each process occupies several centuries. In the case of buried objects in Cyprus the water filtering through the ground makes a deposit on them, more or less thick, of carbonate of lime. I have given seven or eight hours to the microscopic examination of the statuette of Venus, and it is susceptible of scientific demonstration that the surface of the so-called mirror and the surrounding surface are ancient. On the mirror are eight stipples of carbonate of lime, deposited in the way I have stated, which are an integral part of the ancient surface, and would

not appear on a freshly cut surface. These evidences of antiquity could not be taken away without breaking the stone. They fill the cavities whereof I have spoken. They appear on the surface of the drapery within three-sixteenths of an inch of the mirror's outline. My microscope would have disclosed cement 1-1000 of an inch in thickness.”

—o—

GLYCERIN IN MOUNTING.—There can be no question that glycerin is a valuable mounting medium, either alone or mixed with different proportions of water. Nevertheless, we are unable to commend it universally. On the contrary, we are led to doubt if it is so generally useful as some persons would have us believe. There are serious objections to its use with certain delicate animal tissues, unless it be mixed with some hardening agent—such as alcohol—which will counteract its tendency to produce a granular appearance in the tissue. The worst feature of glycerin-mounted specimens is the tendency to become granular. No more striking instance of this can be seen than in mounts of zoöphytes killed with extended tentacles. If glycerin be used for mounting them they lose their character entirely, and nothing but a granular mass is left to suggest the appearance of tentacles. This, to be sure, is a severe test, for it is not easy to preserve such delicate organs in a condition resembling that of life. But the same effect may be seen in other specimens. Those who prepare histological specimens frequently observe the same effect. Dr. Lionel Beale has recommended glycerin as one of the best mediums for mounting such specimens. We are at a loss to account for the great discrepancies in the testimony concerning this subject. No one would question Dr. Beale's testimony as regards his own preparations. All must admit that in his hands glycerin has proved to be an invaluable agent for almost every histological specimen. The fact re-

mains, however, that others have not been successful in its use. Whether the reason is that the glycerin used by different persons possesses different properties, or that there are different methods of using it, or that the specimens mounted are not always properly prepared, it is impossible to say. Certain it is that we have seen so many failures with glycerin mounting—not in the sealing of the cells, which is a very simple matter, but in the preservation of the tissues—that we take occasion to caution microscopists against the too general employment of this agent.

The great value of glycerin in mounting arises from its density and perfectly neutral character. By its use we are able to produce mixtures of any desired specific gravity; and it seems that by mixing glycerin and alcohol and water in proper proportions—as has already been recommended in these columns—the objectionable effects of strong glycerin are avoided. The alcohol seems to harden and preserve the specimens, the glycerin gives density to the medium, which prevents the injurious effects of osmosis that would result with alcohol, or alcohol and water. While we can recommend the use of such a mixture, we would object most decidedly to the employment of a mixture of glycerin and water alone. The hardening effect of the alcohol must be regarded as essential to the preservation of delicate tissues.

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**MICROSCOPICAL SOCIETIES.**—In almost every society there are a certain number of members who are constantly endeavoring to make the meetings more and more interesting and useful. We have always had in mind the interests of such members, and whenever any suggestion has come to us which seemed useful to them it has found its way into the JOURNAL. The plan of giving practical demonstrations at the meetings of societies, illustrating methods of preparing and mounting specimens, has always

seemed a most excellent one. The Quekett Microscopical Club of London adopted this plan some time ago, and it has proved so beneficial in its results that at a recent meeting it was determined to continue the demonstrations during the ensuing year. On the "gossip nights," which are informal gatherings to which members bring their microscopes and objects, it has been decided that there shall be six demonstrations during the year, beginning in December and ending in May. Members are asked to mention the subjects about which they wish to be instructed, and the council then makes a selection of subjects for the different nights, which are announced, with the dates. This plan has proved so satisfactory in London that there is every reason to suppose it would be equally beneficial here.

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**POSTAL MICROSCOPICAL CLUB.**—Early last year we stated our intention to publish notices of the boxes of the Postal Microscopical Club as they came to our hands. It has been clearly impossible for us to do so, but this year, it is hoped, we will be able to get into a new circuit and receive the boxes regularly. We will then fulfil the promises of the year that is passed.

Those who contribute slides should understand that it is not intended to make these notes severely critical. Their purpose is quite different. They are intended to be an aid to those of our subscribers who receive the boxes, by indicating, so far as possible, the most interesting and instructive features of the objects sent around, giving such hints about their preparation and mounting as may occur to us at the time.

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**SENSE OF HEARING IN INSECTS.**—It has long been known, or at least supposed, that some insects are sensible of sounds through the vibration of certain hairs on different parts of the body. It is difficult indeed to prove such a supposition, but very careful ex-



periment and observation have served to strengthen it in several cases. Perhaps the latest observer in this direction is Mr. F. Dahl, who has convinced himself that there are auditory hairs on the arachnida. These hairs are of two kinds, placed on the legs and palps; one is short, of uniform thickness, and fringed at the apex; the other longer and projecting outward more than the ordinary hairs. The former is very mobile, implanted in a cup-shaped depression, and connected with a nerve at the base.

Under the microscope the hairs have been observed to vibrate during the sounding of a note. It is supposed that the different lengths of the hairs adapts them to receiving different notes. The author classifies the spiders of Germany in accordance with the arrangement of the hairs as follows:—

1. *Epeiridæ* and *Theridiidæ*.—Tibia with two rows of auditory hairs; metatarsus with a single hair; tarsus with a depressive, but no projecting hair.

2. *Saltidæ*, *Thomsideæ*, *Lycosidæ*.—Tibia, metatarsus, and tarsus, all with two rows of hairs.

—o—

RESEARCHES ON CHLOROPHYLL.—The coloring matter of chlorophyll has been studied by many persons with a view to determine the modifications to which it is subjected, and also its functions, in the physiological processes of the plant. So many modifications have been found, or so many different coloring principles have been distinguished in it, that the subject is very confusing. The researches of Pringsheim upon the effects of light upon chlorophyll in the plant, and the production of starch, are of great interest, and have already been referred to in these columns.

A. Tschirch has studied the coloring matter of chlorophyll, and some of his experiments may be readily repeated by other observers with great interest. He obtains from an alcoholic solution of the green coloring

matter of plants a substance which he names chlorophyllan, and which appears to be the hypochlorin of Pringsheim. Chlorophyllan is the first product of oxidation of the chlorophyll pigment in the presence of acids, and as vegetable acids are always present in alcoholic solutions of chlorophyll, it is always formed in such solutions. It can be obtained in several ways. Perhaps the simplest method is to evaporate an alcoholic solution of chlorophyll, wash the residue with water, then dissolve in ether, and allow the chlorophyllan to crystallize out of the ethereal solution.

Chlorophyllan is insoluble in water, soluble in alcohol, ether, and benzine, giving brownish-green solutions. It may be reduced by powdered zinc to a green substance, probably identical with chlorophyll.

The yellow substances of chlorophyll can be obtained from a solution of the latter by heating the solution with baryta-water, which produces a precipitate, from which alcohol will dissolve the yellow product or xanthophyll.

To obtain pure chlorophyll the chlorophyllan may be reduced by means of zinc, as already stated, or by treating a concentrated alcoholic solution of the green matter of plants with baric chloride, in which the pure coloring matter is insoluble.

*Spirogyra*, or any of the green algæ which abound in pools and streams, afford a good source of chlorophyll for experiment. They should be cut up and digested in alcohol.

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## CORRESPONDENCE.

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The Measurement of Blood-Corpuscles.

TO THE EDITOR.—I hoped to give, in the January Journal, some further remarks on this subject and some interesting results, but lack of time has prevented. I shall try to do so next month, but in the meantime I think it is well to notice briefly some misinterpretations of my article in the December number.

First: I do not say the average size of human blood discs is  $\frac{1}{2500}$ , but that it is

nearer to it than to  $\frac{1}{3800}$ , and nearer than is commonly believed." I believe the correct average will be found to be below  $\frac{1}{3800}$  and about  $\frac{1}{3850}$  of an inch.

Second: I do not think my words, if carefully read, will support the inference that objectives and apparatus of thirty years ago "were so imperfect that trustworthy results could not be obtained by them." What I say, on page 225, that a comparison made by each microscopist for himself can be relied on by him, applies as well to older as to later measurements. The point of my objection is that while the older work may have been accurate, we have no sufficient proof to justify us in treating it as absolutely so; and when we compare our measurements with the older ones and deduce a result from the coincidence, or lack of it, we are treating the older measurement as absolutely correct.

Third: That the older measurements, even if made with inferior objectives and erroneous micrometers; may indicate correctly relative sizes, I fully concede, and it is clearly set forth in my previous communication. Indeed, correct ruling of the micrometer as to value of spaces is quite unnecessary for a correct comparison of relative sizes; but it is otherwise if the spacing is uneven, and this was the very respect in which the older micrometers were most frequently defective. But the comparison of recent measurements with the old ones to determine a result is treating the older results as absolute sizes instead of relative ones. This I object to.

Fourth: An objective of inferior corrections may give an increased size to the image of the object. With the best present objectives observers will often differ as to the exact focus, and with the older objectives there was even more room for doubt. In many of the old measurements powers of 800, 600, 500, and even lower were used. The error due to coma would be proportionately greater in these measurements than in those with equally imperfect objectives of higher power. If in using a power of 1500 an object  $\frac{1}{3800}$  of an inch in diameter measures 20 divisions of an eyepiece micrometer to one observer and 21 to another, the difference is nearly 5 per cent. I have known this to occur, yet the absolute value of the one space would be but  $\frac{1}{3800}$  of an inch. C. M. VORCE.

—O—

TO THE EDITOR.—In the Microscopical Journal just received, I notice your remarks as to the expulsion of air from microscopic objects by the use of boiled water. Allow me to suggest that when

desiring to wash and mount objects containing a considerable quantity of air, you try the following plan: Take, for example, a collection of *Isthmia*, or some other diatom. The valves enclose so much air as to cause them to float upon water, and it must be extracted, for until they sink it is impossible to wash them. Drive from water all the air you can by a good boiling for about five minutes, allow the water to cool so as to be in condition to absorb air, and without delay drop in the diatoms. The water will extract the air from them and they will go to the bottom. Then add to the water a little dissolved chloride of soda, and, with an occasional shake up, you will find the material pretty well cleaned and bleached in one hour. Wash thoroughly in several changes of water.

Take a drachm of redistilled alcohol and add thereto two drops of dissolved gum Arabic, such as is obtained at an artist's furnishing store. With a sharpened stick place a small quantity on the centre of a cleaned slide. It will spread out and the alcohol will quickly evaporate, leaving a very thin film of the gum. On this gummed spot place a drop of your cleaned diatoms and see that they are thoroughly dried by time or heat. Of course, they are now filled with air and are firmly enough attached to the slide, and can be covered in a cell if a dry mount is desired.

To mount in balsam, however, the air must be again extracted, and at this stage the boiled water prescription cannot be administered. Have Canada balsam made quite tough by age or heat and then dissolved in benzole; and have some pure benzole. Put around the objects which have been dried on the slide a few fragments of cover-glass, and on them, as legs to a stool, place a clean cover-glass. A drop of the pure benzole will quickly run under the cover-glass and very promptly take the place of the air in the diatoms; and a drop of the balsam at one edge of the cover and a corner of blotting-paper at the other will quickly substitute the balsam for the benzole. Time or gentle heat will harden the cement and the specimen is safe.

By the way, unless the object to be mounted is very thick, it is unnecessary to construct a cell. Fragments of cover-glass will save from crushing.

D. S. W.

—O—

"The Science of Fibrine."

TO THE EDITOR.—I have not infrequently seen in microscopical and medical



journals, at home and abroad, references to one of the "investigators" of this fair city. The greater number of these references have not been flattering in tone, while others have been serious and learned attempts to refute the conclusions and teachings of the writer in question.

Dr. Rollin R. Gregg is quite widely known and quoted as an opponent of the germ theory of disease, and as maintaining that the bacteria of disease are only so many varying forms of fibrine. It is not my purpose to uphold or attack the germ theory or the "science of fibrine;" but it seems to me that those who are disposed to take time to answer him, and others who seriously say that he "may be right," ought to know how he "investigates," and then they may know better his ground and better appreciate his conclusions; then they may say whether refutation is necessary, or whether the germ theory will shortly be overturned by him, or the "science of fibrine" "open a new science to the study of man." Dr. Gregg, by the courtesy of the Buffalo Microscopical Club, read before it recently a paper giving the results of his summer's work on boiled blood, rotting blood, and rotting fibrine. The paper bore the title "The Bacteria or Germ Theory of Disease Overturned." Rotting blood and fibrine are pretty likely places to find bacteria, but he found none—all were varying forms of fibrine. The Club appointed a committee to examine the Doctor's evidence. Below is a statement of what was discovered; of what he used to reveal his wonders, and how he managed matters.

The researches were consummated with a Bausch and Lomb "model" stand and a "professional" one-fourth-inch objective. The material to be examined—*i. e.*, boiled blood, blood or fibrine which had been rotting for a longer or shorter time—was, usually, smeared on a glass-slip with a stick and dried, either quickly or slowly; the preparation was then ready for examination, which was done without cover and often with direct sunlight from the mirror. In this way he found all the bacteria of the catalogue and many more not mentioned by the "bacterists." There can be no doubt of it! He uses no staining agents nor cultivation-experiments in the study of these forms, but reasons from appearances obtained as above specified. With such childish work he claims to have overturned the work of masters, and moreover has the boldness to publish such "investigations!"

Bear with me while I state one particu-

lar case to more clearly show the Doctor's methods and reasoning: A drop of fresh blood or of boiled blood, or of an exudation from a blister, is put on a slide and slowly dried; on examination in his usual way certain dark lines appear forming a net-work. Behold the spontaneous organization of fibrine! Again he will not be convinced that drying has had anything to do with his "net-work," but strengthens his position by saying that when sunlight is used for illumination he can see the granules composing the fibrine threads.

It is marvellous. I would not have mentioned this affair had I not thought it due to the readers of his papers to know how his "rough and ready" (Lancet) experiments are performed.

D. S. KELLICOTT.

BUFFALO, N. Y., Dec. 21st, 1883.

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## MICROSCOPICAL SOCIETIES.

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At a meeting of the ILLINOIS STATE Society, held Nov. 9th, Dr. F. W. Mercer exhibited two miniature incandescent Swan lamps, capable of giving respectively two and one-half and four candle power. Their size is not larger than a pea, the shape of one globular and the other somewhat conoidal; one is used beneath the stage for transparent objects, and the other above for opaque objects. The incandescence can be sustained by four Leclanche cells for a period of half an hour, or by means of a storage apparatus, which he also exhibited, for a period of twelve hours. The Doctor claims a superior clearness with this means of illumination over that which is obtained by much more expensive and complicated devices.

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## NOTES.

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—The attention of readers of this number is especially called to the fact that subscriptions must be paid strictly in advance, and that the price will be advanced to \$1.50 after the first day of April, when no subscriptions at the old price will be taken.

—Messrs. J. W. Queen & Co. have issued a two-page circular calling attention to three different series of mounted objects, which, we doubt not, have been prepared in response to a wide-spread demand. We have frequently been asked for mounted specimens of starches and adulterations of food. A few sets we did prepare, but not a sufficient number to meet the demand. Messrs. Queen & Co. now offer a

series of "Vegetal Esculents and Adulterations," which will doubtless have a large sale. They also offer a series of "Textile Fabrics," which it seems would be more properly termed textile fibres, for no woven fabrics are indicated on the list; and they also have a well-selected "Botanical Series."

—We notice, in connection with the above remarks, that it is declared in the price-list of Messrs. Spencer & Co.'s objectives, that there is "no discount from this list." Why cannot other makers and dealers adopt the same principle of business and live up to it? The trade has been demoralized by some dealers constantly offering discounts, until the impression has spread abroad that anybody can get a discount on any stand if he applies to the right dealer. It is not true, to be sure. If stands and objectives are advertised at their proper value, dealers cannot afford to give discounts, and purchasers will be suspicious if they are offered.

—A writer in the *English Mechanic* refers to the hirsute covering of paramecium and other infusoria shown when a solution of quinine is added to the water in which they live, although the cilia are quite invisible when the animals are swimming about. Quinine may prove to be a valuable reagent for killing the infusoria and rendering their cilia visible.

—Our readers will notice that Messrs. H. R. Spencer & Co. have constituted Dr. H. H. Chase sole agent for the sale of their celebrated objectives. The natural inference is that Messrs. Spencer & Co. intend to devote all their energies to the construction of objectives, leaving all business affairs to be taken care of by Dr. Chase. We trust the new arrangement will prove satisfactory in every way, as we doubt not it will.

—Another writer in the same periodical states that the eye of the domestic flea, *Pulex irritans*, is a most beautiful object when seen with a power of 200 diameters with reflected light. It presents the appearance of "a crystalline lens about 1-500 of an inch in diameter surrounded by a dark brown or black rim, and sunk in a depression of the rich chitinous covering of the head. If the light be judiciously applied, this combination of bright light in the lens, with the middle tint of the surrounding yellow skeleton of the head and the dark supplied by the black rim, \* \* presents a combination worthy the study of the trained eye of the artist." The writer goes on to say that the lenticular

properties of the eye may be demonstrated by obtaining an image from the eye, mounted in balsam, on the stage of the microscope, precisely as is done in the familiar experiment with the beetle's eye.

## NOTICES OF BOOKS.

*A Guide to the Microscopical Examination of Drinking Water: With an Appendix on the Microscopical Examination of Air.* By J. D. MacDonald, M. D., R. N., F. R. S., Inspector-General of Hospitals and Fleets, Ex-Professor of Naval Hygiene, Army Medical School. With Twenty-five Lithographic Plates. Second Edition. Philadelphia: P. Blakiston, Son & Co., 1012 Walnut street, 1883. (8vo, pp. 83.)

We are pleased to see a new edition of this excellent work, the plan of which is well adapted to the needs of those who are not familiar with microscopical work, but have occasion to examine water with the microscope. The classification of the organisms described has been slightly changed since the first edition, and the system extended. The specialist might find somewhat to criticise in the arrangement adopted, but for practical purposes it does very well, and, indeed, it would be difficult to improve it.

The author has aimed to produce a book which will guide the observer, by the aid of plates and descriptive text, and a schematic arrangement of the families and genera of the organisms found in water, to a correct determination of their names. In this he has succeeded, we believe, so far as success is possible in the face of the great difficulties involved in the task.

*Report on an Examination of the External Air of Washington:* By J. H. Kidder, Surgeon U. S. Navy. (Extracted from the Report of the Surgeon-General of the Navy for 1880. Washington: Government Printing Office, 1882. (Pamphlet, pp. 24, with 10 plates.)

## Exchanges.

[Exchanges are inserted in this column without charge. They will be strictly limited to mounted objects, and material for mounting.]

Wanted—American foraminiferal material or slides, in exchange for material or slides of foraminifera from green sand, and other formations or recent species.

J. H. HARVEY,

St. John's College, Cambridge, England.

For Exchange—For first-class slides: One Geo. Wale first-class  $\frac{2}{3}$  objective (cost \$10) and two single nose-pieces, made by Schrauer, cost \$3 each. Address W. B. H., Room 27, 24 State street, New York City.



# THE AMERICAN

## MONTHLY

# MICROSCOPICAL JOURNAL

VOL. V.

WASHINGTON, D. C., FEBRUARY, 1884.

No. 2.

### Optical Tube-length and Magnification.

The last number of the JOURNAL of the Royal Microscopical Society contains an article by Mr. Frank Crisp the Secretary of the Society, which shows that the great majority of microscopists have held erroneous opinions concerning the relations of tube-length and the amplification of the optical combination in a microscope. The meaning of ten-inch tube has not been accurately defined, so far as we are aware, in any English textbook on the microscope. In practice some persons measure the tube itself, others say it should be the distance

from the "optical centre" of the objective to the top of the tube, others again measure from the diaphragm of the ocular. The whole matter is in a state of utter confusion, and since the committee of the American Society of Microscopists has likewise been in the dark about the matter, as shown by the report in which the ten inches is measured "from the diaphragm of the ocular to the front lens of the objective," the article by Mr.

Crisp comes in good time.

For the complete consideration of

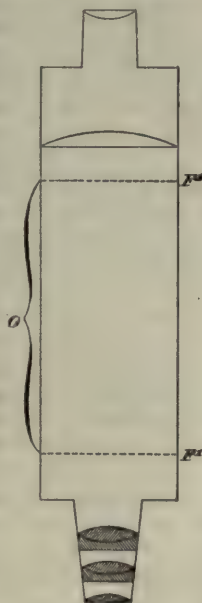


FIG. 3.

this subject the reader is referred to the original article, but sufficient will be given in this place to make the subject clear.

It will be found in practice that:—

"1. Two objectives of precisely the same focal length, used with the same tube and the same eye-piece, may nevertheless give different magnifying powers. 2. Two objectives of different focal lengths, used with the same tube and eye-piece, will not give magnifying powers in proportion to their focal lengths; thus a  $\frac{1}{2}$ -inch will not necessarily give double the power of a 1-inch.

"Conversely, two eye-pieces will not amplify in proportion to their focal lengths, though used with the same tube and objective."

The true magnification may differ by 100 per cent. from the power calculated upon the ordinary assumptions. The explanation is found in the erroneous notions concerning tube-length.

The magnification of a lens is determined by its focal length. It is measured by dividing ten inches, the distance of distinct vision, by the focal length. Let  $f$  = focal length,  $l$  = 10 inches,  $M$  = magnifying power.

Then  $M = \frac{l}{f}$ . For a  $\frac{1}{2}$ -inch,  $M = 10 \div \frac{1}{2} = 20$  diameters. The magnifying power of an objective is immediately given by multiplying the denominator of the fraction expressing its focal length by 10. Thus a  $\frac{1}{2}$  magnifies 50, a  $\frac{1}{4}$ , 60, if the image be received on a screen 10 inches from the posterior focal plane of the lens.

For microscopical use it is necessary to extend this formula to the com-

bination of objective and ocular. Heretofore it has been customary to calculate the power of the compound microscope by multiplying the power of the objective by that of the ocular, assuming the tube to be ten inches long. This rule is founded upon the supposition that the focal length of the combination of objective and ocular is the product of the focal lengths of objective and ocular divided by 10, or  $f = \frac{f^1 \times f^2}{10}$ , in which  $f^1$  = the focal length of the objective and  $f^2$  of the ocular.

This would be true if the optical tube-length were 10 inches, but in practice no distinction is made between the optical and the actual tube-length.

The meaning of optical tube-length must now be explained. In fig. 3 the dotted lines  $F^1$  and  $F^2$  represent the posterior focal plane of the objective and the principal focal plane of the ocular, respectively. The distance from  $F^1$  to  $F^2$  is the optical tube-length.

If this length be represented by  $o$  the true focus of the combination of objective and ocular will be not

$$f = \frac{f^1 \times f^2}{10}, \text{ but } f = \frac{f^1 \times f^2}{o}.$$

The importance of this distinction between actual and optical tube length will be readily appreciated when it is considered that with a  $\frac{1}{4}$ -inch objective the focal plane is close to the back lens, while with a lower power, such as a 1-inch for example, it is considerably removed from it.

—o—

### The Abbe Illuminator.

Mr. J. Grunow, of New-York, gives the following instructions for using this illuminator as constructed by him :—

The apparatus consists of a lens-system of very wide angular aperture, two revolving diaphragm-plates, in conjunction with the plane and concave mirrors on the stand proper. The upper plane side of the lens-sys-

tem should be almost even with the upper surface of the stage, so that it almost comes in contact with the slide. For observation by central light, the diaphragm with central openings is used, viz., a narrower or wider diaphragm, according to the focal distance of the objective in use, the nature of the object-slide, and the intensity of the source of light. Generally, the narrowest diaphragm is to be recommended, as it gives sufficient light. Used without a diaphragm, the condenser invariably gives an unsatisfactory illumination.

By moving the diaphragm openings to the right or left, partly out of the optical axis, oblique illumination is obtained.

For dark field illumination the star-shaped diaphragms are used instead of the aperture for central illumination, and always used in the central position. At the same time it is, however, preferable to reduce the aperture of all the high-power objectives, say from one-fourth inch up, by placing a diaphragm in the back of the objective employed. The diaphragm is, however, to be taken out again in every case when the objective is used for transmitted light. Objects not transparent cannot be viewed by this illumination, as the working rays of light have to pass through.

The polariscope can be used in connection with this apparatus. For this purpose the condenser must have room enough underneath the stage to have an attachment for holding the polarizer. Polarized light can be used then for central as well as oblique illumination.

In using the condenser, the plane mirror is generally used. Only when viewing with very low powers, when the plane mirror does not completely illuminate the whole field of view, the concave mirror is used. In every instance where the mirror is once adjusted for full illumination, the changing of the diaphragms does not affect it.

When using lamp-light, it is recom-



mended to use as large a condensing lens as possible, or perhaps a large glass ball filled with water, in order to secure an evenly illuminated field of view without moving the flame too near the microscope. The condensing lens or the glass ball is placed in such a position between the lamp and the microscope that an image of the flame is projected on the plane mirror.

When, in using immersion lenses, very oblique illumination is desired, or when dark field illumination under high amplification is used, it is advantageous to place a drop of water on the upper surface of the condensing lens of the apparatus, so as to fill up the space between it and the under side of the object-slide with a medium denser than air.

The usefulness of this apparatus has been recognized by all who have become familiar with its use, and it is not only employed as an ordinary accessory, occasionally, but as a constant auxiliary in daily application.

—o—

### New Centering Turn-table.

The turn-table represented in Fig. 4 is the invention of Mr. Joseph Zentmayer, of Philadelphia, and it

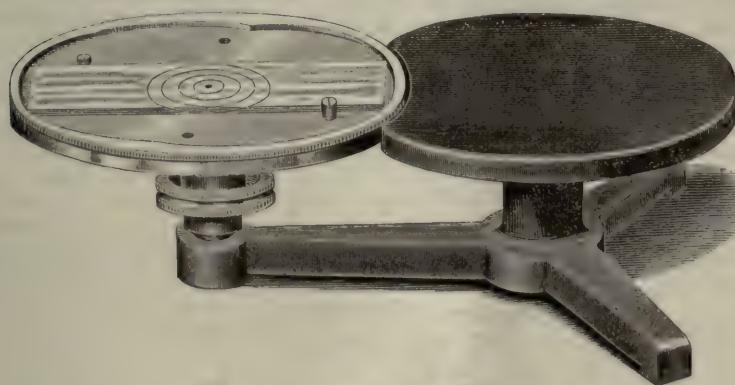


FIG. 4.—Zentmayer Centering Turn-table.

needs no words of ours in its favor when the maker is so well known, for nothing that is not mechanically excellent has ever come from Mr. Zentmayer's hands.

The plan of centering the slide is quite original and perfect in its results. The slide is placed so that its edges are in contact with the two pins projecting from the face of the plate. A ring with an oval inner edge is fitted to the periphery of the disk, in such a way that by turning it the slide is grasped at the diagonally opposite corners by the inner edge of the ring, and is thus centered longitudinally. The two pins centre it the other way.

The ring may be easily removed, and spring clips substituted when desirable.

The figure will afford a better idea of the device than can be given by words. The price of the turn-table is \$5.00.

Next month we shall describe another of Mr. Zentmayer's improvements, which is a new form of detaching nose-piece, the number of which is rapidly increasing.

—o—

### Adulteration of Lard.

Dr. W. T. Belfield describes his method of detecting tallow in lard by the microscope in the *Proc. Am. Soc. Mic.* The process is as follows:—

Ten grains of the material to be examined are dissolved in two drachms of Squibb's ether, in an open test-tube. As the ether evaporates, crystals are deposited. These may be examined in the ethereal solution, but it is better to pour off the mother

liquor and wash the crystals once or twice with clean ether. By thus examining the crystals under the microscope pure lard will show thin, rhomboidal plates, the obtuse angles of

which measure about 105 degrees. Pure tallow appears in long curved crystals, single or in groups. The crystals should be obtained by evaporation in the tube without heat, not by evaporation on the slide. Ten per cent. of tallow in lard can thus be detected, and probably five per cent. The addition of 15 per cent. of lard to tallow was also detected by this method by Dr. Lester Curtis, without experience with the method. It is probable that an experienced observer could detect a still smaller proportion with certainty.

—O—

### A New Infusorian Belonging to the Genus *Pyxicola*.

BY DR. ALFRED C. STOKES.

The loricate infusorium represented in fig. 5, magnified 450 diameters, appears to be

undescribed; but on account of the difficulty a student has of keeping even partially informed of the progress of investigation among the lower forms of animal life, the writer names it *Pyxicola constricta* provisionally. As the animalcule is probably not uncommon, although I have thus far found it in but one locality, it may easily have been described in the recent past and the publication have failed to come to my notice.



FIG. 5.—*Pyxicola constricta*, n. sp. X 450.

The urceolate lorica, slightly curved and gibbously inflated, is widest centrally, whence it gradually diminishes in diameter anteriorly, to the origin of the produced, truncate, obliquely set neck, immediately behind which it is somewhat constricted, and posteriorly to the truncate area of insertion of the short pedicel, above which, at a distance almost equalling the pedicel in height, it is again constricted thus forming a distinct posterior prolongation; the outline of the lorica, as seen in optical section, is more or less irregularly undulate; height about two and one-fourth times the width; it varies with age, as usual, from colorless and hyaline to a semi-opaque chestnut-brown.

Pedicel one-twelfth the height of the lorica, finely striate or wrinkled lengthwise, permanently transparent, but at the point of attachment to the water-weed surrounded by a broad, irregularly outlined annulus, which varies in color with the lorica and is often found adherent to the plant after the entire infusorium has disappeared.

Enclosed animal colorless; when expanded subcylindrical, slightly tapering posteriorly and attached to the lorica through the intermedium of a short, thick, longitudinally and finely striate foot-stalk; when fully extended, about one-fifth of its entire length protrudes beyond the aperture; otherwise it does not apparently differ from the other animals of the genus.

The operculum is conspicuous in the older individuals only, and when retracted completely occludes the orifice at the point of constriction of that part of the lorica which is obliquely produced to form the neck. It is disk-shaped and changes in color with the lorica.

The systole of the pulsating vesicle takes place once in thirty seconds.

Height of the lorica  $\frac{3}{4}$  inch.

One method of reproduction is by the formation of a lateral bud and its subsequent separation as a ciliated germ, whose complete development I have not been able to follow.



This species of pyxicola I have taken attached in some profusion to an alga growing in the Delaware and Raritan Canal, and from that locality only.

TRENTON, N. J.

### Has *Salpingoeca Urceolata*, S. K., a Fresh-Water Habitat?

BY DR. ALFRED C. STOKES.

In this JOURNAL for November last the writer expressed the supposition that *Salpingoeca urceolata*, S. K., is not more restricted to salt-water than is a certain almost cosmopolitan infusorian frequently met with by every

of early spring. At the time, I could not speak with absolute certainty, as this *salpingoeca* seems rather rare, and as I had not captured it again until the article above referred to was in print. Since then, however, I have taken the same creature on *Myriophyllum* from another locality, and, upon comparing this recent find with the description and figures of Kent's typical marine form, the differences appear so slight and the resemblances so many and strong, that an observer must be convinced that it is either *Salpingoeca urceolata* with a fresh-water habitat, or at least a fresh-water variety. The resemblance holds true even in that peculiar and characteristic contractility of the lorica-neck in the marine form.

The lorica of the *salpingoeca* found by the writer is represented in fig. 6 reduced from a pantographic enlargement of a camera drawing. After the animal had been on the slide for some time, the zooid retracted the collar and flagellum, and withdrew itself entirely out of the neck into the body of the lorica; it was in that condition, and was purposely omitted, when the drawing was made to show the similarity of the contracted lorica-neck to the same part in Kent's figure. Differences which I have noticed between the fresh-water and marine forms are the somewhat smaller size of the lorica and the slightly increased length of the pedicel of the former, differences of the very least importance.

May I here also ask the reader's attention to fig. 7 as an interesting deformity? The *salpingoeca* there shown is apparently the species described by the writer in this JOURNAL under the name of *S. acuminata*. How the animal happened to properly form one side of its lorica and to get the other so out of sorts is a mystery. It is easily imagined, however, that after producing the pedicel and the posterior fourth of the sheath, the *salpingoeca* was, by some overwhelming force, thrown against an uneven sur-

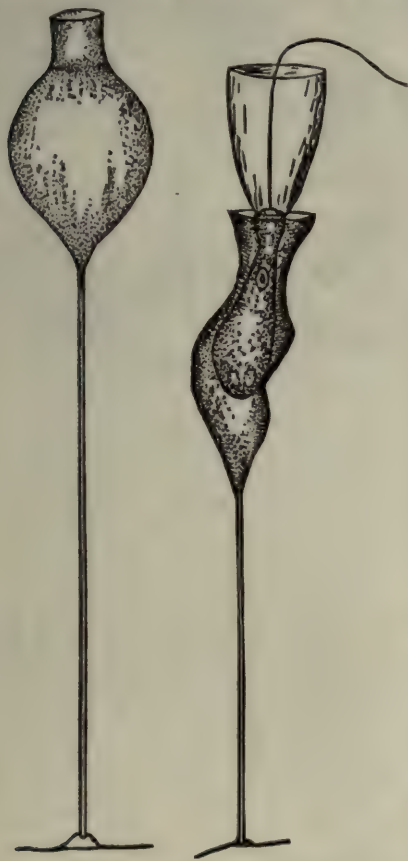


FIG. 6.—*Salpingoeca urceolata*. FIG. 7.—*Salpingoeca acuminata*, deforme I.

observer. The statement was based upon a somewhat limited experience

face from which the young foot-stalk was at that stage not sufficiently elastic to lift it, while the zooid was compelled by some innate influence to continue the secretion of the lorica, so that one side took the shape of its irregular support.

TRENTON, N. J.

### Swift's Fine-Adjustment.

A form of fine-adjustment was introduced by Mr. Swift, of London, some time ago, which we understand is not expensive to make, while it is certainly very effective and smooth in action. If the reader will turn to fig. 45, on page 229 of the preceding volume of this JOURNAL, a cut of a stand with this adjustment will be found. It will be seen that the milled head for fine focussing is placed on the side of the limb, a position which is in some respects advantageous.

The mechanism of the slow motion is shown in fig. 8. By turning the

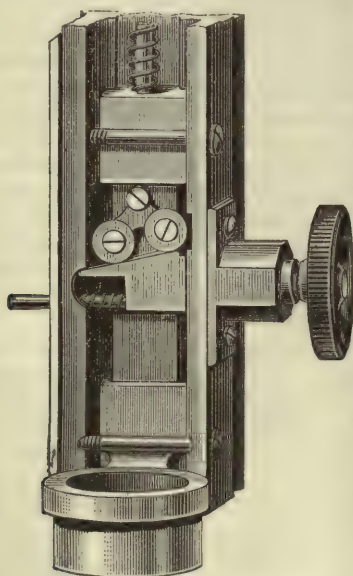


FIG. 8.—Swift's Fine-Adjustment.

milled head the wedge-shaped piece is moved laterally, and thus imparts an up or down motion to the parts bearing on the two rollers.

The same adjustment is applied to

the stand figured in fig. 9, which is also made by Messrs. Swift & Son,



FIG. 9.—Swift's Microscope.

embodying certain features recommended by Mr. E. M. Nelson.

In this stand the stage is cut away in front, so as to afford a view of the substage apparatus, and thus facilitate the use of accessories beneath the stage.

The stand is a very simple and good one. It has a centering substage, with a rack, and diaphragms are attached so as to be readily swung aside and removed from the carrier. The body-tube divides, to make the stand more portable. We have seen this stand used with high-power objectives, for which it is perfectly well adapted.

### Measuring Blood-Corpuseles.

In the December number of this journal was printed an excellent article by that careful and skilful observer,



C. M. Vorce, F. R. M. S., upon *The Microscopical Discrimination of Blood*. The statement was there made—in which I fully concur—that the hitherto accepted standard of the size of the human red blood-corpuscle was erroneous, and that, if measurements were carefully made with the best modern appliances, Gulliver's standard of  $\frac{1}{3200}$  of an inch “will be found to be nearer to  $\frac{1}{3400}$  inch than is generally supposed.”

I have hitherto pointed out the unreliability of the so-called “standard measurements” of blood-corpuscles, and have cautioned observers against accepting them as a means of differentiating human and animal red blood-corpuscles. The size of any minute object must be determined by the observer himself, without regard to the published opinion of another. Let him determine the size of the object viewed by his own standard, which is sufficiently reliable for his own purpose in making comparative measurements. How many of the ruled spaces of his micrometer does the object occupy? That is all he desires to know. It matters not whether he calls it the  $\frac{1}{3200}$  of an inch or the  $\frac{1}{3400}$  of a furlong. What is the measurement on his micrometer? That will not vary—it will always represent precisely the same member of lines to him, which, for purposes of comparison, are perfectly trustworthy. To the practical worker in micrometry, it is apparent that this plan must be adopted until, as Mr. Vorce suggests, an identical standard of measurement is adopted, with which all our micrometers are compared and rated. Until then, every observer must maintain his own standard.

The editor of the *AM. MONTHLY MICR. JOURNAL*, in commenting upon Mr. Vorce's paper, makes the following statement: “If, as the author states, it be found that the average size of human blood-corpuscles is  $\frac{1}{3400}$  instead of  $\frac{1}{3200}$  of an inch, it needs no words to point out how uncertain are the assumptions upon which expert

testimony has been founded.” And again, “It is well, therefore, that the sources of error should be set forth; and we trust the article will prove a serious obstacle to those who, with undue assurance, venture to recognize human blood.”

It would seem that the Editor does not take into consideration the fact that, if, according to Mr. Vorce's measurements of the human blood-corpuscle, it is found to be nearer  $\frac{1}{3400}$ , according to his micrometer, that the corpuscle of animals must vary in like ratio. If Gulliver concluded the human corpuscle to average  $\frac{1}{3200}$  of an inch, and the pig corpuscle  $\frac{1}{4200}$ , then, would not Mr. Vorce, in applying his micrometer to the human corpuscles and finding them to measure  $\frac{1}{3400}$  of an inch, find also, by the same rule, the pig's to measure  $\frac{1}{4400}$  of an inch or smaller? Would not the prevailing difference in size still exist—as shown by Gulliver—when measured by Mr. Vorce? If not, why not?

THAD. S. UP DE GRAFF.  
ELMIRA, N. Y.

[To the question just stated we reply, certainly the relative sizes would be the same. The important question still remaining unsettled is, whether the difference in the size of human blood-corpuscles and those of certain domestic animals is sufficient to enable them to be distinguished with certainty.—ED.]

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### Microscopical Technic.

#### I. APPARATUS AND MATERIAL.

The present article upon this subject is intended as an introduction to a series which has been more fully announced in another column. It embraces a brief description of the apparatus and material required for mounting. At the end of the article will be found a list of the essentials, which the beginner would do well to obtain. It is recommended that all the apparatus should be prepared or purchased at the beginning, as noth-

ing is here mentioned that is not really useful in general mounting.

Treating first of the apparatus, a small alcohol lamp and a brass mounting table will be necessary. The latter can be obtained, very neatly made, from dealers in microscopical apparatus, but a good substitute can be devised by supporting a plate of brass about  $\frac{1}{8}$  of an inch in thickness in any convenient way over the lamp. The brass should be placed so far above the lamp that the heat from the latter will cause Canada balsam to harden rapidly without changing its color. If balsam is heated too much it turns yellow. A temperature just a trifle higher than the hand can bear is about right.

Needles mounted in wooden handles can be purchased, or they may be readily mounted at home. There should be several of them, of different sizes, very delicate ones to use in working on the stage of the microscope, others for ordinary use. One method of mounting a needle is to break off the eye and sharpen the upper end. Then seizing the needle firmly in a pliers or a vise, force the sharpened end well into the wood, in which process a hammer may be necessary. In this way the natural point of the needle is left uninjured. The needle should project about  $\frac{3}{8}$  of an inch from the wood, and the latter should be cut down to the needle, like the sharpened end of a pencil. Two rather strong needles should be inserted in one handle, close together, as this makes a very useful instrument.

Another method of inserting the needles is to split the end of the holder, lay the needle in position in the slit, and secure it in place by wrapping thread around the holder, thus closing the slit, after which the whole may be covered with shellac or liquid marine glue.

A small pair of surgeon's scissors, such as are used in operations on the eye, form an essential part of one's outfit for dissecting small objects.

Straight scissors are better than those with blades turned at an angle—the crook is always the wrong way for the work now under consideration. A small knife with a keen edge is also necessary. Both these instruments can be obtained, of proper form, from dealers in microscopes or in surgical instruments.

Forceps are to be very carefully chosen. We would advise three kinds, two small ones of steel, which should be the best of surgeon's fine forceps, one straight, the other with curved ends. The points of these should come accurately together, as they may be required to pick up the smallest particles or filaments. The third pair should be of brass with the ends curved, carefully made, and about 5 inches long. Such forceps are not very often seen, but we selected a pair from Mr. Woolman's stock long ago, and they have proved invaluable in many ways. They are useless for dissecting purposes, for which the steel ones are eminently fitted, but they are useful for innumerable other purposes, to which the steel ones are usually applied with great inconvenience. They will hold a thin cover-glass securely—which the fine steel ones were never known to do. They require so little force to close them that there is no fear of dropping a specimen by tiring the muscles, or injuring it by too much pressure. They are invaluable for dipping into bottles of water to select filaments of algæ, portions of plants, etc., for examination, or for handling sections and objects of all kinds.

Glass tubes are almost universally used in microscopical work for dipping up water and other fluids, but in many cases solid glass rods are preferable, since they can be more readily cleaned. Tubes should be cut of the desired length, and one end drawn off to a smaller aperture, for which purpose a spirit lamp affords sufficient heat. Heat the tube, and gradually draw it out, then draw a file across the narrowed portion and break it



square off. Smooth both ends by heating them in the flame, while constantly turning the tube on its axis.

It is an excellent plan to have constantly on the table with the microscope a wide-mouth bottle of 3-4 ounces capacity filled with clean water in which the tubes and rods in use are placed. Such a bottle of tubes should be always at hand, while making observations, as it ensures clean tubes and fresh water, which are in constant demand.

Medicine droppers are very convenient for applying reagents drop by drop. They may be inserted through the corks of reagent bottles, and thus be ready for instant use. A solid glass rod, however, running through the cork will serve every purpose.

For cleaning cover-glasses it is well to have a couple of large flat corks covered with chamois skin on one side. By placing the cover-glass between them and rubbing, it is well cleaned and polished. Many persons, however, clean their cover-glasses with a bit of soft cloth, and after a very little practice not many need be broken in this way.

In mounting objects it will be frequently necessary to hold the cover-glasses down firmly. This is often done by the aid of brass clips made for the purpose, but a more convenient method is to use heavy rifle bullets, which can be set upon the cover and left until the cement is quite stiff and hard. The bullets should be heavy, weighing fully an ounce.

For mounting objects of considerable thickness rings with an external diameter slightly greater than the cover-glasses must be used. Rings of gutta-percha, paper, block-tin, and of almost every imaginable substance have been used, but as it is not intended to exhaust the subject in the articles, but to indicate what is good and readily obtained by any person, we only recommend the common brass curtain-rings, which can be obtained suitable for  $\frac{3}{8}$  and  $\frac{1}{2}$  covers at the hardware shops for a few cents per dozen.

A good turn-table is essential if neat mounts are to be made. A self-centering one saves time and is a great convenience, but many of the best mounters do not use them. There are so many forms of turn-tables in the market that it is hard to say what are the most desirable ones. Bulloch's "volute" turn-table is a most excellent one. A good form was introduced some time ago by Messrs. Bausch and Lomb,\* and Mr. Zentmayer has just perfected a new one, which is described in these columns this month.

Passing now to a consideration of cements, varnishes, etc., only those will be mentioned that are known to be durable. The number of cements used by different persons in mounting is surprising, considering that a very few of them serve for all purposes, and have been proved durable by long use. If the reader desires to make a series of comparative experiments on cements, that is one thing, but if he desires to mount objects for permanent use he had better leave such experimenting to others. No definite results can be obtained concerning the value of a cement in less than three or four years' time, and even this period is not sufficient for positive conclusions. It is therefore better to use cements that are known to be satisfactory, and in this article we propose to mention only such as we know to be reliable.

At the head of the list, as being more universally useful than any other, we would place shellac dissolved in alcohol. The simple alcoholic solution of brown shellac, with a few drops of castor oil to make it flow better, is what we have used most frequently. There are various mixtures sold, however, in which shellac is the basis that are said to be superior to the simple solution. Among these the best known are Bell's cement, and Ward's brown cement. The great fault of shellac is its brittleness. This, however, is of

\* Vol. ii, p. 226.

no consequence if it be used only for sealing the cells, and some more elastic cement be used afterward to protect it. Shellac cement may be made by dissolving shellac in alcohol, but to get a clear solution the insoluble portion must be allowed to settle, and this requires days or weeks. It is better, therefore, to purchase the solution from a paint shop, where it can usually be obtained quite clear. A few drops of castor oil to each ounce of solution will improve it. It is well to have two solutions of shellac, one rather thick—as thick as it will flow from the brush—and another much thinner.

Canada balsam is a most useful medium if used with discretion. It has been too generally employed, however, and many good specimens are spoiled by mounting them in Canada balsam. The balsam should be clear and very slightly colored. It is well to purchase two or three ounces from a druggist for stock balsam, and after taking out a small portion for immediate use, place the bottle in a window exposed to the sun. This will bleach the balsam, and in a few weeks it will be almost colorless. The best balsam to buy is old balsam which is likely to be tough and hard, but in case that cannot be obtained soft balsam must be hardened by heat. The best way to prepare such balsam is to place it in a wide-mouth bottle, covered with paper to exclude dust, and set the bottle in a dish of water on the back of a stove where it will keep warm but not become hot enough to be uncomfortable to the hand.

Test the balsam from time to time by allowing a drop to thoroughly harden on a slip of glass. When cold it should resist the finger-nail but it should not be brittle.

From this balsam several preparations should be made:—

1. Benzole balsam. This is a rather thick solution of the hardened balsam dissolved in pure benzole.

2. Chloroform balsam. This is similar to the preceding solution,

chloroform being used instead of benzole.

3. A thin solution in either benzole or chloroform, which will run freely from a brush. This is used in mounting for making rings and finishing slides.

Excellent balsam, and solutions in either of the above-named solvents, can be obtained from dealers in microscopical materials.

Damar is a mounting medium in great favor with some persons, and is an excellent substitute for Canada balsam. It is used in solution, and had best be purchased ready for use, as it is rather troublesome to prepare.

A material for mounting which has been much condemned by many persons, but which in our hands has always proved satisfactory, is wax. We have used it very largely for mounting opaque objects, selecting for the purpose sheets of the dark, olive green sold for making artificial flowers. It is but just to add that the objections raised against its use are sustained by many high authorities. The greatest objection is the tendency to the condensation of minute drops upon the cover-glass, obscuring the object. Never having been troubled with this, we shall describe the method of mounting with wax in the course of these articles.

Glycerin jelly is an excellent medium for mounting, especially for vegetable tissues. This had best be purchased, although it is not especially difficult to make. It is composed of a solution of gelatin to which a certain quantity of glycerin has been added. The formula for preparing it will be given if any reader desires it, in a future article.

White zinc cement has been much used, and is, unfortunately, still employed, to some extent. It is a very pleasing cement to work with, but all we can say of it is that if the preparer wishes to be assured that a certain proportion of his mounts will be spoiled sooner or later by the running in of the cement, let him use the white



zinc. The writer once made a white zinc cement which has stood the test of years, but it was made with shellac as a basis.

For a black finish for mounts there is nothing superior to the asphalt, or Brunswick black sold by the opticians. We do not commend this as a cement, but only as a brilliant, black finish for mounts. One of the best mixtures that can be devised is composed of equal parts of asphalt and gold-size. We shall have frequent occasion to refer to it in the course of these articles. Gold-size is frequently used alone as a cement, and for making rings on slides for mounting. It is a great favorite with some persons, but we do not advise its use.

Having thus briefly alluded to the materials required for mounting, the more interesting part of the subject will be opened next month, when the different kinds of mounting will be discussed, and some hints given to enable the beginner to choose the proper method for preserving any specimen.

The following list of articles that should be obtained will be of assistance to those readers who may desire to have all the essentials for mounting at hand. It includes all the articles mentioned above, and a few others :—

#### APPARATUS.

Spirit lamp.  
Brass mounting table.  
Mounted needles.  
Small surgeon's scissors.  
Small surgeon's knife.  
Steel forceps, straight and curved.  
Brass forceps, curved.  
Dipping tubes and rods.  
Medicine droppers,  $\frac{1}{2}$  doz.  
Bullets for weights.  
Curtain rings for  $\frac{3}{8}$  and  $\frac{5}{8}$  covers.  
Turn-table.  
Gun-punches,  $\frac{3}{8}$  and  $\frac{5}{8}$ -inch, for cutting wax.  
Cover-glasses, No. 2 round, diameters  $\frac{3}{8}$ ,  $\frac{5}{8}$ , and  $\frac{7}{8}$ -inch.

#### MOUNTING MEDIA AND CEMENTS.

Alcoholic shellac.  
Bell's cement.

Canada balsam.

Canada balsam in benzole or chloroform.

Damar medium.

Sheets of dark olive wax.

Glycerin jelly.

Brunswick black.

Gold-size.

Carbolic acid, crystallized.

Pure glycerin.

Alcohol.

Turpentine.

Oil of cajaput or eucalyptus oil.

#### New Method of Detecting Trichina in Meat.\*

Slices, two or three millimetres in thickness, are taken from several different parts of the meat to be examined. The pieces are preferably taken from the surface of the muscular portion of the meat. A series of thin sections are made of each of the pieces, and these are all plunged into a solution composed of methyl green 1 gramme, distilled water 30 grammes. After about ten minutes' maceration the sections are taken out, and placed to decolorize in a large vessel filled with distilled water. They remain there about half an hour, the water being agitated and changed two or three times. Finally, the water having become quite limpid, it is stirred up with a glass rod, interposing the vessel between the eye and the light, when the sections containing the trichinae are distinguished quite readily with the naked eye. The trichinae appear in the form of small, elongated particles, of a fine blue color. The methyl green becomes fixed to the cysts of the trichinae with greater tenacity than to the other parts of the tissue.

It suffices then to examine the sections with a magnification of fifty diameters to distinguish the worm which will be found enclosed in the cyst.

If, in following this method, no trichinae are found, it is positive assurance that the meat is not infested with them.

\* *Bull. de la Soc. Belge de Micr.*

### The Mosquito.

Mr. J. L. De La Cour read the following interesting account of the mosquito at a meeting of the Camden Microscopical Society, in December last. Although to most readers the theme may seem out of season, to residents of New Jersey it may be different. He said:—

The mosquito is a singularly unpleasant insect in a room, but it is marvellously beautiful under the microscope, and should be examined with a succession of powers, so as to gain its beauties of detail by degrees. The antenna of the male is a wondrously beautiful object; there are 14 joints, each finished with a whorl of long hair. The antenna of the female has the hair so short as to be invisible without the aid of a lens; the wings, beak, and limbs are generally studded with scales, which give to the insect a splendor of coloring which cannot be appreciated without the microscope, when they blaze out in a magnificence rivalling the fabled glories of Aladdin's palace.

We must bear in mind that though both sexes partake of this splendid apparel, the male does not possess the piercing lancets with which the female is armed. The male mosquito is, in fact, harmless. Life is absolutely rendered a burden by these tiny insects in countries where their numbers are multiplied by the millions, and the venom of their bite is increased tenfold where they assume to themselves the mastery of the section in which they live. Their habitat is world wide, and no amount of thick clothing in many instances could defend us from their attacks.

Their visible proboscis is not the sting itself, but the scabbard enclosing the instruments for piercing the skin and sucking our blood. There are five lancet-like bristles with a hook in the end, which are left on the arm if the insect be driven away suddenly and cause greater pain and inflammation than if allowed to be withdrawn by the insect when it has ceased suck-

ing. The itching sensation and swelling of the insignificant puncture is then caused by the venomous saliva, which is discharged from the sting for the purpose probably of diluting the blood. We see the same thing when flies drop some liquid on a lump of sugar in order to dissolve it, that they may the better suck it up. This saliva therefore performs the same office as that of mammals when masticating their food.

Mosquitoes deposit their eggs in stagnant water, about 300 at a time, which are multiplied by those of six or seven generations in one season. Their immense number would give us much trouble in every section of the country were they not the favorite food of many birds (particularly of swallows), as well as dragon flies and other insects. If we reflect for a moment on the fact that of about one hundred eggs laid by the dragon fly, perhaps only one pair survive, and that the remaining 98 young have afforded food to insects of other species, we can form an idea of the amount of food required from the larval state to the winged state, and be impressed with the fact that the majority of insects are born to serve as food for the few that survive.

The eggs are of an oval form perpendicularly glued together in masses of a shape resembling that of the lifeboat now in use, and like it cannot be sunk, and if capsized rights itself again immediately. They are at first white but become green after a few hours and afterward gray. In about three or four days the egg is hatched and the larva pushes off the lower end of the egg, which opens like a circular trap door, and allows it to float off into the water and become one of the wigglers which we see. The head and thorax are so large and bulky that it cannot ascend and lie motionless in a horizontal position, but hangs head downward, and breathes by means of a spiracle lodged in one of the large tubes into which the end of the body subdivides, the position of the tube be-



ing maintained by a pencil of radiating hairs attached to a short projection at the end of the body. After shedding the larval skin several times, in two weeks they assume the pupal state and become now tumblers. In this stage the mosquito is quite a different being; it scorns food of all sorts, and, like some religious devotee, lives on air alone and that in homœopathic doses, for the reason that all the apparatus of its mouth is enveloped in the pupal skin, and now instead of breathing through its tail it bears two club-shaped respiratory tubes, which are situated on the site of the future thoracic spiracles of the perfect gnat.

After passing a week in this state the pupa cracks along the back and through the aperture the head and legs appear, and finally the imago, which shakes out its damp and crumpled wings, and as soon as this is completed the mosquito flies serenely away.

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## EDITORIAL.

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**Publisher's Notices.**—All communications, remittances, exchanges, etc., should be addressed to the Editor, P. O. Box 630, Washington, D. C.

Remittances should be made by postal notes, money orders, or by money sent in registered letters. Drafts should be made payable in Washington, New York, Boston, or Philadelphia.

Subscription-price before April 1st, \$1 per year, in advance. All subscriptions after this month begin with the February number. After April 1st the subscription-price will be \$1.50.

The regular receipt of the JOURNAL will be an acknowledgment of payment.

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**SPECIAL NOTICE.**—Attention is particularly called to the conditions of subscription for the current year, which, as already announced, must be paid in advance. Also to the change in price after the 1st of April from \$1 to \$1.50. We trust that none of our former subscribers will defer payment and then complain that they do not, as heretofore, receive the JOURNAL. Having established a rule, it must act impartially, and in opening the new subscription-book no names will be entered until payment is made. This number is sent to former subscribers who have not yet paid as a specimen number.

**POSTAL-CLUB BOXES.**—Box V comes to us with six slides, all in good condition. Slides 1-4 are from Dr. A. W. Waterhouse, of Jamestown, N. Y.; 5 is from Mr. R. R. Rogers, and 6 from Mr. Samuel G. Love, of the same place. The first is a preparation showing the sperm-duct and ova-duct in a joint of a tape-worm, in which the male organ especially is well shown. A few words of description would have greatly increased the interest of the object. Indeed, the same may be said of each slide in the box, for not one of them has a word of description appended. The sperm-duct is the coiled tube distinctly seen in the specimen. The ova are irregularly scattered through the specimen. It should be remembered that the tape-worm has no special digestive apparatus; it absorbs all its nutriment through the superficial envelopes of the body.

Slides 2 and 3 are plant sections, both of which are too thick—a fault which we should attribute, from their appearance, to a dull knife rather than to want of skill on the part of the preparer. The section of *Calla* shows this defect about the margin, where the cells are spread out laterally by the pressure of the cover-glass. This is, indeed, a difficult section to prepare, as it must be made very thin, and unless the knife be very sharp the soft, internal parts will be torn.

Slide 4 shows the cuticle of the petal of *Gladiolus*, which needs a description to make it worthy of special notice. The pollen of the mountain ash on the next slide would be far more interesting if mounted in a medium of less refractive power than damar. Castor oil is a good medium for pollen. The last slide shows a transverse section of the gizzard of a turkey, in which the "horny papillæ of the lining membrane" are well shown, although a better preparation would be cut thinner.

Box K passed into this circuit January 24th, containing five slides.

1. *Scirrhus Mammæ*. Dr. George O. Mitchell. A. M. Ross remarks about this that it is "too thick to be examined with very high power, but there seems to be no variation from the form of hard cancer of female breast."

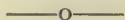
2. Zoophyte. Wm. Farnell. It is named *Cellaria avicularia*, which seems to be a mistake. It is a good mount, but the specimen is not so clean as it might be made by thorough washing in the manner we described some time ago.

3. Transverse section of the ovary of *Cactus grandiflora*. Dr. J. Kruttschnitt. Illustrating his investigations of the process of fertilization.

4. A slide by F. A. Chase, who desires to learn the name of a specimen of which he had lost the record. M. A. Booth says it is the scales of some plant, probably *Tillandsia*, not *T. usneoides*.

5. Section of Ivory Nut. G. W. Hubbard.

6. Foraminifera—*Orbitolites complanata* and *O. duplex*. R. Hitchcock. This slide was added to replace the missing one. The specimens are from the "Challenger" collections, upon which Dr. B. W. Carpenter's recently published monograph was founded.



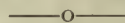
AMERICAN SOCIETY OF MICROSCOPISTS.—The *Proceedings* of the sixth annual meeting of this Society, which was held at Chicago last August, have been issued in a volume of 275 pages. The editorial work has been well done and has been pushed rapidly or the volume would not now be ready. We congratulate the Society on the efficient services rendered by the Committee on Publication.

The articles published are numerous, some of them possessing considerable scientific value. The first is the address of the President, Prof. A. McCalla, on "The Verification of Microscopic Observation," which covers a wide field. It would require too much space to allude to the articles

in succession, but some of them will be noticed elsewhere in these columns. Perhaps the most valuable part of the volume, from a scientific point of view, is that which relates to the ruling of lines upon glass with a diamond—a subject which has been already brought before the readers of this JOURNAL in considerable detail, and the whole of that portion treating of the standard micrometer "A," which has been subjected to critical study by Prof. W. A. Rogers with results which are tabulated and fully reported.

The volume is by far the largest and most interesting yet published by the Society. The work is so well done that we are not disposed to offer a word of criticism; but it seems doubtful if the long report of the "conversazione," especially the list of objects exhibited, adds to the value or interest of the volume, while it certainly does to the cost.

Copies can be obtained from Prof. D. S. Kellicott, of Buffalo, N. Y. The price we do not know.



THE STANDARD MICROMETER.—This micrometer, now belonging to the American Society of Microscopists, is held by the Treasurer and Custodian of the Society, who is authorized to lend it only to persons "of eminent ability." Three copies, however, are to be made by Prof. Rogers, any one of which can be obtained by any person by depositing \$10.00 with the Treasurer and paying the charges of transportation to and from the Treasurer's office. In this way microscopists will be enabled to compare their micrometers with the standard.

It is the duty of the Custodian to make comparisons of all micrometers sent to him for that purpose, or to have such comparisons made by a competent person, charging a reasonable fee for the work.

The charges for comparisons should be fixed at an early day, and it is to be hoped the work will be placed in



the hands of competent and experienced observers.

Certificates stating the errors should accompany each micrometer examined. Makers of micrometers, or those who sell them, could then offer for sale micrometers with the certificates, adding the cost of the certificates to the price of the micrometers. This would be a great convenience to purchasers, obviating the necessity of sending their micrometers away to be compared, which involves some risk in transportation.

Now that a standard micrometer has been adopted and the whole matter finally settled, it may not be inappropriate to refer to our own connection with the movement which has resulted so satisfactorily, and to call to mind a few circumstances of interest in connection with it. The subject was first brought before the Society by the editor of this JOURNAL at the Indianapolis meeting. At that meeting the matter was referred to a committee, and since then we have taken no active part in the discussions before the Society, although our interest in the matter has never failed. We are especially well pleased to know that the unselfish and meritorious labors of Prof. W. A. Rogers in this field are receiving from the Society due, though tardy, recognition.

Some of our readers will remember that there was considerable discussion about the unit to be adopted by the Society. The unit proposed by ourselves was the  $\frac{1}{100}$  mm. for the small divisions of the standard, and the  $\frac{1}{1000}$  mm. as the micrometric unit,\* in which measurements were to be expressed. No special credit is due for this proposition, for it was a natural outgrowth of the requirements of the time. Yet it was amusing to notice the opposition aroused. Passing over the arguments directed against the micron unit and in favor of some division of the inch, it will be remembered that when the  $\frac{1}{100}$  mm. was

proposed it was roundly criticised as being too small, and the New-York Society, after commending it, was led to retract resolutions passed in its favor, without, as we believed at the time, due consideration. Nevertheless, when the matter was finally considered with care, the  $\frac{1}{100}$  mm. was found to be not too small but too large for convenience as a unit, and the  $\frac{1}{1000}$  mm. or micron was finally adopted. The standard is precisely what was recommended by us more than five years ago.

—o—

MICROSCOPICAL MATERIAL FOR DISTRIBUTION.—We have received ninety applications for oyster spat, and quite a large number for Barbadoes polycystina. The whole of the oyster spat has now been distributed among subscribers. Every applicant has, we trust, received a sufficient quantity to make two or more good mounts. It is probable that some have been disappointed with the small quantity sent, but all of the best material, with the exception of a very small amount reserved for personal use, was divided up as evenly as possible and sent away. We have still a very small quantity of inferior material remaining, which we do not wish to send out, although with care it might be utilized.

We have to announce that the supply of Barbadoes earth for distribution is also exhausted. Each of the packages sent out contained sufficient material to repay the trouble of cleaning. The best process of treating the material will be given next month, as we have no room for it in this number.

Some other specimens, principally deposits containing diatoms from celebrated localities, will soon be offered to subscribers to this JOURNAL. Further announcement will be made next month, and the localities of the deposits named.

—o—

STAINING NUCLEI.—The columns of this JOURNAL contain a great variety of formulæ for staining and

\**Am. Quart. Micr. Journ.*, I, 235.

otherwise preparing minute organisms for mounting, so as to reveal their internal structure. In giving Dr. Gruber's method of staining protozoa, in addition to the others, it is with the desire that our readers should have a method at command which has proved entirely successful by application to one of the most common microscopic organisms, *Actinosphærium*. This organism is best killed under the cover-glass by running in a 20-per-cent. solution of chromic acid, although Mr. Saville Kent recommends the use of a solution of iodine for the purpose, as already mentioned in these columns. For killing amœbæ absolute alcohol serves very well. Wiegert's picrocarmine is the staining agent used by Dr. Gruber, dilute alcohol being used to wash the specimens.

By staining with the picro-carmin the author was able, after the examination of numerous specimens of *Actinosphærium*, to observe the division of the nucleus. This phenomenon takes place very rapidly, and all appearance of fission disappears very quickly after division. Hence it is seldom observed, and must be sought for with great care.

The same is true of *Amœba proteus*. Division is but rarely observed in the nucleus, and when it does take place it seems to be a very simple form of division, in which the nucleus is first seen to divide into two parts, after which the new cortical layer of the daughter nuclei is developed between them.

The author thus distinguishes between what he designates as indirect division, in which the nucleoli are primarily affected, and direct division, in which the nucleus divides by the ordinary hour-glass constriction.

—o—

TRICHINÆ IN PORK.—A few years ago no one would have supposed the American hog to be capable of attracting so much attention and creating such a stir in high places as it has lately done. Whether the Govern-

ment of France will be made to tremble down to its foundations for casting an unjust slight upon our porkers remains to be seen.

It appears that considerable energy has been displayed by some persons in France to make it seem dangerous to use American pork as an article of diet, and, as though to keep the breeze blowing, one of the gentlemen engaged in investigating the diseases of domestic animals for our own Department of Agriculture recently contrived to get the Department into hot water about the matter, and has found it necessary to deny the authorship of certain remarks attributed to him and publicly repeated in Paris.

M. Paul Bert, one of the leading physicians in his country, has placed himself in an embarrassing position before the world, all on account of the American porker. He has made himself responsible for the publicly expressed opinion that trichinosis is not uncommon in France. This, however, is quite contrary to the opinions of medical gentlemen in general, and it appears very much as though M. Bert had said that which is not quite true for the purpose of injuring the prospects of the innocent American hog. M. Bert's confreres in the medical profession must feel greatly flattered by his explanation of why he holds opinions so different from theirs. In brief, it is this: They mistake trichinosis for typhoid fever! Such little episodes as this, perhaps, lead the way to a better knowledge of the subject than would otherwise be obtained, for it is likely this soft impeachment of French physicians by one of their number will raise a commotion that will ensure correct diagnosis of trichinosis hereafter.

To bring the matter home, when the subject was first brought before the United States authorities, it was impossible for them to say much about it. Nobody could tell what proportion of American pork was infested with the worms. The subject had to be investigated. It has been



investigated, and now it must be admitted that a very considerable proportion of our pork is trichinous; what proportion we cannot state, but it is just as well not to eat very much pork before it is cooked.

There is another side to this matter, however, as concerns the legislation in foreign lands. Although cases of trichinae occur from time to time in France, and particularly in German countries, not one single case, so far as we are aware, has been traced to the use of American pork. There is very strong probability, if we cannot say absolute certainty, that the salting kills the worms, so that they are harmless by the time they arrive across the water.

—o—

**CUTTING SECTIONS IN RIBBONS.**—The process of cutting sections in ribbons, recently introduced, is much employed in the laboratory of the Johns Hopkins University, where we had the pleasure of witnessing the operation. We are indebted to Prof. W. K. Brooks for kindly illustrating the process and some of its results.

The object of the process is to enable the observer to cut a series of extremely thin sections of any soft preparation, such as an embryo for example, and to mount the sections in a series in the order of succession, retaining all the parts of the specimen in their proper position. The value of the process needs no further explanation. It is carried out perfectly, and in an exceedingly simple manner.

The specimen is first properly prepared, and imbedded in paraffin. The paraffin is then placed in the section cutter, which is made on the principle of the Rivet microtome, although much longer than the usual form of the latter instrument, and somewhat modified in the details of construction. Sections are then rapidly cut, by moving the knife forward and backward within proper limits, and the successive sections of paraffin, which are square, adhere together by their edges into a ribbon, which may grow to an

indefinite length. It is essential that the paraffin be of the proper consistency and at the right temperature.

Slides are now prepared by spreading a thin layer of shellac dissolved in creosote on one surface, to which the ribbons are now transferred, two or three being placed parallel on each slide so that the sections may be readily examined in succession. By heating for a short time in a warm oven the sections become firmly attached to the slide, and may be mounted in balsam with very little trouble. As a result of this method of procedure we were shown a series of sections across the body of *Lingula*, in which the arms were shown in section precisely as in life, and in the stomach were remains of diatoms quite undisturbed by the operations of preparation.

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## NOTES.

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—Dr. F. M. Hamlin advises the use of crimson lake as a color for the ground of opaque mounts. When the object is white he considers this better than a black ground, but for objects of different colors he selects a ground which seems to show them best.

—We have been much interested in the account by Prof. John M. Coulter of the development of a dandelion flower, which was read at the Minneapolis meeting of the A. A. S., and has now been published with illustrations. It is a very well-written and instructive article, especially for botanists.

—Dr. Allen Y. Moore has sent us a slide of *Amphipleura pellucida*, prepared by himself in a mounting medium, which he states has an index of refraction of 2.30. We have not yet been able to examine the diatom with sufficient care to justify any extended notice at this time, but we can say the appearance of the frustule is quite remarkable. It can be distinctly seen under a low-power objective under circumstances that a specimen in balsam would be quite invisible. Dr. Moore states he has "had no difficulty in seeing the dots on the valves with my Spencer  $\frac{1}{16}$  N. A. 1.35, with Beck's vertical illuminator, using lamplight."

—The Rev. Fayette Hurd, who has long been working on the problem of produc-

ing a cheap and at the same time a serviceable microscope that would pack into a small box, has finally succeeded in perfecting a design which he believes will prove satisfactory. From the drawings we would say the plan seems feasible, and worthy of being put in practice. A really good and cheap microscope, that can be carried about in a small valise when one goes off for a visit, is still a desideratum. Mr. Hurd calculates that his will pack in a case  $5 \times 2\frac{1}{2} \times 1\frac{1}{2}$  inches, inside measurement.

—Mr. J. W. Dunkerley, F. R. M. S., has lately contributed some articles on the anatomy and development of the *Hydra* to *The Microscopical News* (Manchester, England). In his last communication he describes some experiments in watching the growth of portions of a dissected *Hydra vulgaris*. A tentacle removed from the body showed contraction and expansion, and in one hour a change in form was observable. In seven days tentacles began to show themselves at one end, which was formerly the free end of the tentacle, and on the fifteenth day there were seven tentacles, and the new hydra began to take food. The body of the original hydra had been divided longitudinally and the two parts rapidly recovered from their injuries, forming two individuals. The author finds that hydras which have been divided "grow much larger, and bud more freely than those not operated upon."

—The slides of the different forms of pathogenic bacteria now being advertised by Mr. Hinrichs, of Baltimore, are prepared by Dr. G. Marpmann, of Esens, Germany. We have seen several preparations of the *Bacillus Kochii*, more commonly known as *B. tuberculosis*, which were excellent. If the others are equally good, we doubt not many readers will be glad to secure a full series of specimens.

—The Rev. A. B. Hervey, whose name is familiar to all readers of this JOURNAL, and especially to those who study the marine algæ, has nearly completed the translating and editing of a work which will surely be of great value to all microscopists who are engaged in scientific work with the microscope. It is a new book by Dr. Behrens, treating of the methods of conducting microscopical investigations in the botanical laboratory, but the American edition will contain much additional matter drawn from the experience of Mr. Hervey and other American investigators. We await its appearance with much interest.

## CORRESPONDENCE.

### The "Congress" Nose-piece.

TO THE EDITOR.—Mr. W. H. Bulloch has announced a new adjustable nose-piece as his own invention, when it is, in truth, entirely my own; invented three years ago, and shown in drawings to a number of microscopists at the Detroit meeting in 1880 and at various times since, and referred to briefly in my Presidential address at Chicago before the American Society of Microscopists last August. Unwisely I allowed the pressure of other matters in my too busy life to prevent me from taking more active measures to bring my invention before the general microscopical public, though intending from month to month to send a description of it to your JOURNAL. Greatly disappointed that I had allowed myself to be so busy as to neglect bringing it formally and in detail before the A. S. M. at its last meeting, I asked Mr. Bulloch, at that meeting, to make up some nose-pieces according to my plan, that they might be shown to the Society at its next meeting, and brought into general use. He at once consented to do so, and I described the plan of my invention to him, and sketched in pencil its very simple details. After some months' delay he made it up and sent me a specimen for approval and further suggestions. I sent a brief acknowledgment of his letter and of the instrument itself on a postal card, and was preparing to send a more detailed letter, when I was surprised by seeing the nose-piece figured and described as an invention of Mr. Bulloch's, and a patented one at that.

I greatly regret that he has taken this step, especially as I had freely offered the use of my invention to him and to Messrs. Bausch and Lomb three years ago, and to Mr. Griffith and others since. Desiring that microscopists everywhere should have the benefit of what I deemed a valuable improvement in the instrument, I asked nothing for the privilege of its manufacture save recognition of the fact that I was the inventor.

At that time, however, the time was not ripe. Makers and users were satisfied to regard the society screw, and the double or triple nose-piece as quite sufficient for all needs, and I was too busy with other matters to urge my device into notice. Within the past year a number of other devices have been brought out, such as Sidle's bayonet catch, Pease's "facility," Nelson's slotted screw, etc., all aiming to accomplish the end I had already



reached; so that Mr. Bulloch acceded very promptly to my request that he should make up the nose-piece he had thought of no importance three years before, and he now publishes it as the most perfect means yet devised of securing the objective to the tube, and of rapidly interchanging one objective for another. I shall hope yet to be assured that Mr. Bulloch's failure to credit me with the invention was an oversight, and, in that hope, will say no more about it at present.

ALBERT MCCALLA.

FAIRFIELD, Iowa, Dec. 31st, 1883.

#### Cleaning Slides and Covers.

TO THE EDITOR.—I would like to ask, through the columns of your JOURNAL, for a simple and efficient method of cleaning off old balsam-mounted slides and covers. No doubt some of your subscribers can furnish the desired information, and it will be as useful, perhaps, to many of your readers as to the writer. G. T.

[The question is submitted to the readers of the JOURNAL who can doubtless contribute useful hints for cleaning slides. Our correspondent might try, meanwhile, strong sulphuric acid containing some crystals of potassic bichromate, allowing the slides to remain several days in the liquid.—Ed.]

### MICROSCOPICAL SOCIETIES.

The LEHIGH VALLEY Microscopical Society of Easton, Pa., held an exhibition at the rooms of the Y. M. C. A. of that place on the evening of November 1st. Dr. Amos Seip, the president, delivered a short address, and a large number of fine objects were shown by the members. We make the following extracts from Dr. Seip's address:—

"The object of this meeting to-night is to afford our friends and all lovers of microscopy an opportunity to examine the display of the various kinds of microscopes, and to give an exhibition of objects both natural and prepared, thereby showing more of the wonderful power of the instrument, and to afford an evening of enjoyment by the exhibition of some of the finer objects in nature and art, which can only be seen by its use. We hope also to give an impetus to the study of our favorite science, and possibly develop sufficient interest in the community that may ultimately lead to more practical results. The value of the microscope in the arts and sciences is fully acknowl-

edged and appreciated, but as a factor in education in the school-room and family it is comparatively unknown. The use of a microscope in the home circle would not only afford a most interesting study and much enjoyment, but would go far in moulding character and developing the mind. \* \* \* \* \*

"We sometimes hear it sneeringly stated that the microscope is overrated; that the benefits resulting from its use by the physicians are exaggerated and not founded in fact. Why, if it were possible for me to enumerate but a tithe of its capabilities and of the advantages, nay, the necessities, of its almost daily use by the physician, you would be astonished; time would fail. I dare scarcely allude to the subject. To the physician the microscope is from the very first a necessity for his instruction. In pursuing his investigations it gradually becomes a delight and attraction which captivates its employer and leads him on in the boundless fields of science which it unfolds, and illuminates with a beauty of design and structure of which no description can give an adequate idea, and leads him irresistibly on and upward through nature to nature's God.

"A physician must either be himself a microscopist, or he must almost daily make use of one for the necessary information to practise his profession correctly, conscientiously, and successfully.

"By means of this instrument, and by it alone, we can observe the wonderful process of the development of the body from a simple cell. With it and the information it gives we can now recognize and cure diseases that are local and parasitic, that were long held to be constitutional. By it we examine the various secretions and excretions of the body and at once determine the nature of the disease, whether functional or structural. By it the brilliant discoveries of Koch, Pasteur, Tyndall, and others, were rendered possible, and which have covered them with undying fame.

"But a short time since the startling intelligence was flashed from Egypt that Koch, the discoverer of the *Bacillus tuberculosis*, claims to have discovered the cause of Asiatic cholera; that he has found it to be due to microscopic organizations of a thread-like character, somewhat resembling the bacillus of consumption. Should his observations be verified it will add another to the triumphs of the microscope in modern medicine.

"And now, gentlemen of the Lehigh Valley Microscopical Society, permit me to

congratulate you, each and all, who have aided in the formation of this organization, not yet three years old. It is growing stronger and shows unmistakable evidence of its vitality. Let us move onward in the good work. Let us not forget that it was the genius and work of an American who first taught the world how to make good objectives. It remained for the skill and energy of Spencer, whose angles stretched far beyond the limits which had been fixed as the boundaries of the possible, and which rendered possible the resolution of diatoms, which had previously resisted all attempts to show their lines. It was the study of these little things which has led a philosopher to call God great in great things, yet greatest in smallest. Finally, let us hope that the experiences of this evening may strengthen the bonds of friendship; which a common love for microscopic science has created, and this exhibition, the first, may not be the last, but that its display of instruments and objects will so interest all who are with us, that we may have their sympathy and encouragement in our beautiful studies and stimulate us to start for broader and wider fields."

### NOTICES OF BOOKS.

*Bacteria.* By Dr. Antoine Magnin, Licentiate of Natural Sciences; Chief of the practical labors in natural history to the faculty of medicine of Lyons; Laureate of the faculty of medicine of Paris (silver medal 1876); General Secretary of the Botanical Society of Lyons, etc., and George M. Sternberg, M. D., F. R. M. S., Major and Surgeon U. S. Army; Member of the Biological Society of Washington; Late member of the Havana Yellow Fever Commission of the National Board of Health; Corresponding Member of the Epidemiological Society of London, etc., New-York: William Wood and Company, 56 and 58 Lafayette Place, 1884. (8vo, pp. 494.)

In this book the reader will find a compendium of the present knowledge of the bacteria, and their relations to disease. It is a book that may be read with profit by the general reader, and is at the same time a valuable work of reference for the physician and the specialist in the study of infectious diseases.

As a translation it is capable of great improvement. The French idiom makes very bad English, and a translator should guard against the tendency to literally trans-

cribe the words of a foreign tongue. Faults of this nature, and occasionally errors in translation, occur too frequently. These, however, are not of a kind to effect the scientific value of the book.

It is divided into two parts: 1, Morphology, and 2, Physiology of the Bacteria. The second part is especially good. The author's position respecting the germ theory of disease is both conservative and judicious, in the present state of knowledge. It is to be noted that the doubts of a careful observer are worthy of more consideration, in a matter of this kind, than the conclusions of many speculative thinkers or inexperienced investigators. There is no evident intention to detract from the value of work like that of Burdon, Sanderson, Pasteur, and Koch, but in venturing to criticize or question some of their conclusions, the author manifests a laudable purpose to establish, if possible, upon a basis of fact, the validity of the results obtained by experiment.

The French author appears not to be particularly well acquainted with the work of American and English observers, as many familiar names are omitted where they deserve to be mentioned.

The volume is illustrated by twelve fine heliotype plates, and twenty-five woodcuts. An excellent bibliography completes the work, and greatly adds to its usefulness.

*Fourth Annual Report of the State Board of Health, Lunacy, and Charity of Massachusetts, 1883.* Supplement containing the Report and Papers on Public Health. Boston: Wright & Potter Printing Co., State Printers, 1883. (Pamphlet, pp. 260.)

This report contains a valuable contribution, of 86 pages, on the Adulteration of Food by S. P. Sharples, S. B., who has done much valuable work on the subject.

### Exchanges.

[Exchanges are inserted in this column without charge. They will be strictly limited to mounted objects, and material for mounting.]

Wanted—Physiological and Pathological preparations in exchange for Gorgonias, Starches, Microfungi, Vegetable Hairs, &c.

W. R. MANDEVILLE, M. D.,  
154 Canal St., New Orleans, La.

Wanted—American foraminiferal material or slides, in exchange for material or slides of foraminifera from green sand, and other formations, or recent species.

J. H. HARVEY  
St. John's College, Cambridge, England.

For Exchange—For first-class slides: One Geo. Wale first-class  $\frac{3}{8}$  objective (cost \$10) and two single nose-pieces, made by Schrauer, cost \$3 each. Address W. B. H., Room 27, 24 State street, New York City.



# THE AMERICAN MONTHLY MICROSCOPICAL JOURNAL

VOL. V.

WASHINGTON, D. C., MARCH, 1884.

No. 3.

## Serial Arrangement of Birotulate Spicules in Statoblasts of American Sponges.

BY HENRY MILLS.

The most common of the fresh-water sponges is that known as *Spongilla fluviatilis*, Bk., *Meyenia fluviatilis*, Carter. This species, in

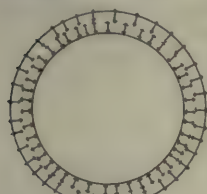


FIG. 10.—Statoblast of sponge.

some of its forms, occurs in most of our rivers and ponds where the conditions are suitable to sponge growth. The varieties are numerous in this country, and they differ so widely from each other that it might be less confusing to regard some of them as distinct species. In the course of my collecting tours last summer and fall, I gathered many specimens which, at first, presented the appearance of one or other of the varieties of this sponge which is described and figured in its typical form in Bowerbank's *Work on Sponges*, vol. 1, plate xxii, fig. 319; also by Carter in the *Ann. and Mag. Nat. History* of February, 1881.

In the latter part of October, 1883, while examining a specimen found in Ischua creek, Franklinville, N. Y., I was surprised at the peculiar and well-rounded statoblasts, and resolved not to pass them by without an effort to learn more about them. For the purpose of a more critical examination, I embedded a suitable piece of the sponge in hot paraffin, and cut thin sections of the statoblasts,

afterwards mounting them in Canada balsam. I was well rewarded for my trouble, for to my surprise and delight the wall of the statoblast in section presented a serial arrangement of the birotulate spicules, one above another (fig. 10), which was as beautiful as it was unique to me. In these statoblasts the primary rotules of the first series rest on the chitinous coat; the secondary rotules of the same series extend about half way through the wall. The secondary series, without resting on the first, extends from about half way in the wall to the outer crust and a little beyond. In a few cases, however, I have found three series of the birotulates, the first and third arranged as above, with a second intermediate. The appearance of these statoblasts in section is well shown in the figure, in which it will be seen that the two series of birotulate spicules are quite regularly arranged about the central cavity, forming a strong, resisting, and protective envelope. The appearance under the microscope is very beautiful, as the form of the spicules is better seen than in the cut. Whether this is constant, but to be seen only when the sections have been cut favorably for showing their position, or whether it is casual and abnormal, further observations are necessary to determine. Without accurate measurement I consider the birotulates of each series to be alike. The shafts are not spined, but are almost cylindrical, having but little of the hour-glass shape, as Mr. Carter calls it, as distinguished from those of the ordinary *Meyenia fluvi-*

*atilis*. I subsequently found two other specimens, one from Bear creek, Benton Co., Iowa, and another in the Calumet creek, 16 miles south of Chicago, having the same interesting peculiarity.

Although the skeleton spicules and statoblasts of these forms differ widely from each other, yet the arrangement and form of the birotulate spicules appear similar. After this discovery I immediately searched the literature at hand on the subject, but can find no reference nor the remotest hint at anything of the kind. I wrote to Mr. Potts of Philadelphia, who is good authority on fresh-water sponges. He kindly forwarded to me a few statoblasts of a sponge sent to him by Mr. Carter two years ago, which, he considers, show the same arrangement, although, as it had never been described nor figured, he thought it should be. This sponge is the *Spongilla Meyeni* of Carter, lately merged by him with the *Meyenia fluviatilis*. It was discovered in Bombay, India, and described by Mr. Carter with others discovered by him at that place in 1849. Bowerbank notices the sponge in his first volume of "British Spongiadae," pages 136, 137, and takes issue with Mr. Carter's remarks on the construction of the walls of the statoblast. Evidently at that time neither of these gentlemen had noticed the serial character of the birotulates in the wall of the statoblasts.

Since the above was handed to the editor for publication I have received, through the further kindness of Mr. Potts, a pamphlet describing and figuring a similar serial arrangement of the birotulates by Dr. Franz Vejdovsky, of Prague, and also a line from Mr. Carter, of England, stating that Dr. Vejdovsky's paper translated, with remarks by himself, would be published in the February number of *Ann. Mag. Nat. History*. In a future paper to the JOURNAL I hope to figure and describe the three American species found by myself.

BUFFALO, N. Y., Jan. 8th, 1884.

### Mr. Zentmayer's Nose-piece.

Last month a reference was made to a new nose-piece devised by Mr. J. Zentmayer. It is illustrated in fig. 11.

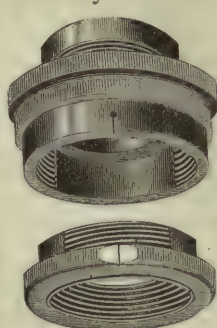


FIG. 11.

It may be of interest to briefly indicate how the plan originated, as we have the account in a private letter from Mr. Zentmayer. He writes substantially as follows: "The principle of attaching by partly removed threads of screws and nuts is

old and was used years ago on breech-loaders in Germany, later for drill chucks, and a gentleman in this city years ago attached his objectives by this means. I thought the matter over, but came to the conclusion that it was useless to adopt that method unless all the prominent manufacturers would agree to cut the screw-threads of objectives and nut in the same relation. Seeing the difficulty of establishing such a relation I dropped it, but not without thinking seriously to adopt it for such stands as were furnished with my own objectives. \* \* \* I dropped the matter until I saw the 'facility' nose-piece and the adaptation of a collar to the objective. Thus the difficulty was solved. By means of the collar I can manufacture a nose-piece and collar for any objective without having either at hand."

The plan of cutting away the screw-thread of the objective itself which Mr. Zentmayer at first proposed, is now carried out in England by one manufacturer, Mr. Swift. It is an old plan, which has never found much favor for some quite unaccountable reason. It will be seen from the illustration that the plan adopted by Mr. Zentmayer is to put a small collar on the objective and cut away opposite quarters of the threads of that collar, leaving the original thread on the objective intact. The adapter,



which screws on just like an objective, has a jam-nut to keep it secure.

The advantages of this nose-piece are that it is very small and light, the objectives with the rings attached fit in their boxes, and objectives are readily attached and removed from the stand with one hand, almost instantaneously.

—O—

## New Members of the Infusorian Order Choano-Flagellata, S. K.

BY DR. ALFRED C. STOKES.

### II.

It has seemed surprising to the writer that the beautiful little zooids which the latest authority has grouped together under the title of choano-flagellata not only remained so long unseen by human eyes, but that even after their discovery by the distinguished observer in our own country, Prof. H. James-Clark, they were not again recorded from America until their rediscovery in English and German waters. The cause could scarcely have been in their minuteness, although that is sufficiently conspicuous, if anything so small can ever be considered conspicuous, to tax the best of good objectives in the study of their structure. Aside, however, from the extreme delicacy of their membranous and collar-like food-trap, and the length of the filamentous foot-stalk and flagellum, there is little about them to compel a good lens to pass them by unseen. It is true that to study the collar a high-power objective of the best class is needed, but to search for them as they live on the leaflets of submerged plants, and even to make out the contour of their bodies, only a good glass of medium power is demanded. The writer has little trouble in finding them by searching about the *Myriophyllum* and other aquatic weeds bearing similarly dissected leaves, with a Tolles'  $\frac{1}{10}$ -inch objective,  $90^\circ$  to  $120^\circ$  aperture. Yet it must be remembered that in this case familiarity leads to a confidence in the ordinal

identity of the brilliant object that greater amplification seldom destroys.

The reader surely understands that I am not making the absurd claim that an unknown infusorian 0.0002-inch long can be identified with a  $\frac{1}{10}$ -inch objective. But for an observer familiar with the appearance of the choano-flagellata such a glass will suffice to pick them out, and to an educated eye it will, among the salpingæcæ more especially, frequently indicate their species. I refer to this particular objective by the lamented Mr. Tolles because I have had no experience with any other of the same denomination. The members of the order to which these papers more particularly refer, however, although first noticed with the Tolles objective, were studied with Bausch and Lomb's homogeneous  $\frac{1}{8}$ , N. A. 1.43, and a similar immersion  $\frac{1}{10}$ , N. A. 1.35, by Spencer, and a water-immersion  $\frac{1}{18}$  of  $175^\circ$  by the former makers.

Whatever may have been the cause, these exquisite flowers of the lakes and seas were apparently forgotten until Mr. W. Saville Kent discovered in England Prof. James-Clark's species of *Codosiga* and *Salpingæca*, adding many new forms to those genera, besides establishing the genera *Monosiga*, *Astrosiga*, and *Desmarella*. In Germany little has been done among them; in our own country still less. Whether this is because of their minuteness, the small number of observers, or the use of French triplets, is a question; but the fact remains, and is all the more a cause of wonderment when we consider their abundance and almost cosmopolitan habitat.

The following presumably undescribed species of *Codosiga* (fig. 12) is a very characteristic form, found in considerable numbers attached to the dead and decaying leaflets of *Myriophyllum* from an aquarium. Aside from its distinctive shape, it has one marked peculiarity which has not before come to my notice with any other of these creatures. It is that of fre-

quently masquerading as a species of another genus. When a colony,



FIG. 12. — *Codosiga florea*, n. sp.

which I have never seen composed of more than four individuals, has been under observation for a short time, one of the zooids suddenly, and for no discoverable reason, often droops and hangs against the foot-stalk like a flower withering on its stem. A moment later it begins a rapid rotation on its longitudinal axis, and, having twisted itself free, darts in an uncertain, zig-zag course backward through the water. I have seen this occur only when the colony is formed of two members. Occasionally another method of parting company is adopted. The discontented one visibly lengthens its special foot-stalk until it is two or three times the height of the body, and then twists free. The part of this freshly-formed pedicel left on the primary foot-stalk, as well as that carried off by the migrating animal, does not harden in the water, but speedily becomes invisible, in the former instance seeming to melt away, in the latter to be absorbed.

After a longer or shorter voyage the traveller settles down somewhere and proceeds to erect a pedicel of its own, so that the preparation on the stage soon shows many collar-bearing monads suspended from the cover-glass, lifting themselves from the slide, or resting on the water-weed, each new foot-stalk varying in length with age, and bearing but one terminal zooid. It is now a monosiga, only needing to assume a method of reproduction by transverse fission to remain a monosiga; and the observer, unless he has first become acquainted with a normal colony, and has witnessed the results of these curious antics, would

be more than excusable for a wrong classification of the little creatures. Its reproductive division is, however, longitudinal, as with all species of its genus.

The shape of the body during the monosiga-phase does not conspicuously vary from that of the mature animals composing a colony. It is shortly campanulate, the height,  $\frac{1}{4500}$  to  $\frac{1}{5000}$ -inch, but little exceeding the width, the posterior part usually evenly rounded, very seldom tapering to the pedicel, and bearing on the anterior body-half a characteristic, equatorial groove or depression. In form it is somewhat changeable. As a monosiga, the part immediately beneath the insertion of the collar expands, the opposite extremity contracts, and the creature then presents an appearance amusingly like the corolla of a monopetalous flower. As a *codosiga* the bodies at the insertion of the foot-stalk at times somewhat tapers, and the internal or opposing surfaces become flattened, thus giving the exterior lateral outline a somewhat gibbous contour.

The depression surrounding the body is permanent. When the animal is killed with picro-carminé it sometimes expands greatly in front and to the rear of this groove, so that the dead body becomes fiddle-shaped. This change I have not observed to take place after using other chemicals, and not always with picro-carminé. The slender pedicel of course varies in length with the maturity of the creature it supports. When of age, or often when the zooids part company, each to assume the monosiga phase, the pedicel is usually from six to eight times the height of the body. Instances do rarely occur when the body of a single animal is only one-fourteenth the height of the foot-stalk; the little zooid having apparently spent its substance in the formation of a stem that shall over-top all its competitors. Similar occurrences are not so uncommon among individuals of the genus *Homo*.



The attractiveness and the delicacy of this pretty creature elude the pencil and the graver. Be the portrait ever so accurate, it still lacks the charm of the living original. I have never seen it, either standing alone or as a true *Codosiga*, without thinking of a garden in the spring with its lilies-of-the-valley blooming in the shade. Associating it with the flowers is a pleasure; so, as a new species, *Codosiga florea*, let it be. The following description will probably be sufficient for its identification:—

*Codosiga florea*, n. sp.—Body shortly campanulate, the length but slightly exceeding the width, the change in shape consisting chiefly of an anterior marginal dilatation, usually rounded posteriorly, and bearing on the anterior body-half a permanent equatorially disposed groove; pedicel slender, eight to ten times the body in height, the secondary pedicels short; contractile vesicles several. Length of body  $\frac{1}{4000}$  to  $\frac{1}{3000}$ -inch. Habitat.—Fresh-water. Solitary.

TRENTON, N. J.

—o—

### Structure of the Diatom-Shell.—I.

BY JACOB D. COX, LL. D., F. R. M. S.,  
PRES. AM. SOC. OF MICR.

I propose to give some of the results of a series of observations upon the structure of the diatom-shell, reaching through a number of years past, and of which my note-books contain full memoranda. These observations have been repeated, varied, and verified, until the conclusions drawn from them seem to be based on sound induction from solidly established facts. I shall endeavor, however, to state my methods of examination and the kinds of examples used in such a way that students of this department of microscopical botany may easily follow and repeat my experiments.

In observations with transmitted light I prefer balsam-mounted slides, illuminated by a narrow, central pencil of light. My illuminator has usu-

ally been the Webster achromatic condenser with a metal slide behind it having an opening a quarter of an inch in diameter. When used with lamplight a pale, violet-blue glass modifier is behind the condenser. Oblique light is necessary for the resolution of fine striæ, and every method of examination is to be used for comparison; but the confusion caused by shifting and crossing diffraction effects at every change of the mirror is to be avoided as likely to lead to error in studying the shell-structure. Hence, the choice of the small central beam of light, made as free from glare and cross-lights as possible. The objective, on the other hand, should be of largest aperture, for experience and comparison quickly prove that such a glass has great superiority in the way in which it takes hold of a surface and defines the edges of areolæ and of fractured margins of the silicious plates, and discriminates films and laminae in different planes.

In working with reflected light, it is worth while to seek every assistance which skilful opticians can give us. Every increase of power in the examination of diatoms as opaque objects is a great gain, and there is no direction in which painstaking labor brings a better return. For this reason glasses of large working distance are very desirable. Mr. Tolles' quarter-inch objective with tapered nose is a valuable lens for such purposes. Bausch & Lomb are also making an excellent quarter-inch of about seventy-five degrees angle which can be used on opaque mounts. Problems which seem almost insoluble when objects are examined by transmitted light are sometimes cleared up in a moment when they are treated as opaque objects.

The vertical illuminator also gives us a mode of using reflected light with high powers, the value of which can hardly be overestimated. It is sometimes said that it is only of use for those parts of objects which are in actual contact with the cover-glass;

but this is a mistake. It is useful for all that is within the working distance of the objective. It requires a more careful collar-adjustment of the glass, and an attention to the manipulation of the light which is troublesome; but it gives us facts which we can get in no other way. It is almost impossible to get the field free from glare, but this is chiefly due to the reflection of light from objects not in focus, and does not prevent our getting sharp delineation of the surface which is properly focussed upon, and the discomfort and inconvenience can well be borne for the sake of the increase of knowledge of objects which we get. It has been a rule with me, therefore, to consider my examination of any diatom incomplete until the diatom has been subjected to careful and repeated observations with the vertical illuminator. It is a matter of regret that it is not always easy to obtain for this purpose dry mounts of thoroughly well-cleaned material burnt upon the cover-glass.

*Triceratium favus*.—In studying the diatom-valve, the natural course is to begin with the coarser and more strongly marked forms, and proceed toward the finer and more delicate. Microscopists are generally agreed that the hexagonal marking of *Triceratium favus*, of *Coscinodiscus radiatus*, and of other species of similar appearance, is caused by an arrangement of cells of true honeycomb form. That these areolæ are closed at one end has been proved in the case of *Triceratium* by the well-known appearance of smaller dots within the hexagons; but whether both ends are closed has been a vexed question, which it is almost impossible to decide from the study of transparent specimens. Here the examination of an opaque mount quickly removes all doubt. Take Möller's beautiful slide of Cuxhaven diatoms, mounted opaque for the Lieberkuhn, and use upon it one of the quarter-inch objectives mentioned above, or Spencer's two-thirds of forty-seven

degrees with a half-inch solid ocular. If we find a valve of *T. favus* with the convex side uppermost, we shall see a white surface, regularly studded with circular bosses, or dark spots, looking as if they were a bubble-like film of the siliceous lifted a little above the general surface. Each of these is in the centre of a hexagon distinctly traced about it, and when the surface is accurately in focus we find that there is no elevation of the dark spot, but that the appearance is due to the fact that the siliceous is extremely thin over it, being, therefore, nearly black and transparent, like very thin clear ice in a pond, whilst it grows thicker toward the walls of the areola, assuming the dead-white appearance which gives all the thicker diatoms on the slide the look of biscuit porcelain. The three horns, and the general convexity of the valve, show that we are looking at its outer surface. Let us find now, as we easily may, a valve with its concave or inner surface turned upward. If we use the binocular instrument, the depth of the hollow shell and the projection of the sides of the valve toward us are very striking. With the higher ocular we notice that the walls of the valve are quite thick, and that they have cross-lines indicating a cellular structure. On focussing upon the interior surface of the shell we find the same black-line tracing of hexagons which was seen on the convex surface, but the area of each hexagon is flat and white. Careful examination with the highest ocular the objective will bear shows that the white surface is dotted.

We must now seek the assistance of a more powerful objective and the vertical illuminator, using a dry mount of any gathering in which the *Triceratium* is found. The conclusions we have drawn from the appearance of the convex surface of the valve are now corroborated, and we find the concave surface strikingly even, the hexagonal marking being only a dark outline in the general plane; but we also find that the dots



which we had glimpsed before are a regular system covering the whole surface, and radiating in straight lines from the centre of the valve to the sides of the triangle. This inner film, therefore, if it were separated from the honeycomb behind it, would be a shell of itself, marked somewhat like *Trinacria Regina*, but much finer. The dark hexagonal lines show the attachment to the deep hexagonal walls of the areolæ within, and the dark spots upon the upper surface of the valve show that the upper ends of the areolæ are dome-shaped within. A valve inclined at an angle to the light will show that these spots are not holes in the upper surface, but that the silex film is continuous and evenly curved with the general contour of the shell.

Returning now to a balsam mount, and using a high power with transmitted light, it will be found that in the case of a valve with the concave side toward the eye, after adjusting the lens carefully upon the finely dotted film, we may lower the tube and find the "eye-spot" in a plane considerable lower. Or if we choose a valve with the convex side upward, after focussing sharply upon the edge of the hexagons, we shall have to go deeper to bring the "dots" into focus. In the last case the upper lamina of the shell, being without distinguishing marks, is not visible by transmitted light.

We have thus been led to the conclusion that the *Triceratium* is formed of two laminæ connected by a hexagonal net-work, of which the areolæ are about as deep as the diameter of the hexagons; that the inner of these laminæ is finely dotted with lines of punctæ radiant from the centre of the triangle, and that the outer lamina is very thin over the centre of each hexagon, to which it is firmly connected by the walls of the areolæ, which are thickened so as to give a hemispherical interior form to the upper end of each.

*Eupodiscus argus*.—The structure

of *Eupodiscus argus* was at one time a good deal discussed, and Mr. Stodder gave what seems to be nearly the true description of this shell. The opaque Cuxhaven slide is full of excellent examples of it, and the quarter-inch objective suffices to determine its form beyond dispute. The convex surface is found to be deeply pitted with irregular areolæ having very thick walls, looking very much like the exterior of a peach stone in the character of the depressions and their relative size when compared to the thick walls around them. No shifting of light gives any trace of a film covering these areolæ on this side; but they retain the dead-white color in whatever direction they are seen. Broken fragments found here and there show the section of the areolæ, with the boldly-projecting and heavy net-work of walls. The processes stand out like horns of the clearest glass. The concave surface presents a striking contrast to this. It is smooth and well glazed, but on carefully manipulating the light we find in this, as on the inner surface of the *Triceratium*, a system of dots in radiating lines, resembling a good deal the marking of *Actinocyclus Ralfsii*, a shell which is also abundant in this gathering. On the inner surface of the *Eupodiscus* will also be found indentations marking the bases of the processes and fitting into them.

In examining transparent slides of the same material, I have occasionally found a shell of *E. argus* in which the heavy net-work had been partly removed by accident, and the semi-opaque and characteristic appearance which the valve ordinarily has was in contrast, side by side, with the interior film, as if the specimen had been artificially prepared for the demonstration. The areolation varies in different shells. In some it is almost as regular in pattern as some examples of *Coscinodiscus radiatus*. In others it is hard to see any approach to regularity of arrangement,

but the type may be fairly considered a subhexagonal arrangement of areolæ in the outer lamina of the valve, the walls of these areolæ being extraordinarily thickened outwardly, making a rough honeycombed surface. The inner lamina has its independent system of very fine circular dots in radiating lines, and some of these are seen at the bottom of the bright areolæ when the diatom is examined by transmitted light.

*Coscinodiscus Oculus-Iridis.* —

This diatom has also been the subject of discussion, the result of which is a general agreement that its hexagonal markings indicate the walls of true areolæ, which lie between two plates in a manner similar to that which we have found in *Triceratium favus*. Mr. Stephenson reported some years ago (*M. M. J.*, vol. x, p. 1) his examination of it in bi-sulphide of carbon, and noted the fact that the inner lamina was sometimes found separated from the outer. He found the hexagons persistently attached to the outer lamina, only the faint outline being seen on the inner plate when detached. This latter, however, showed "eye-spots" approximately in the centre of each hexagon, and these consisted of circular concavities in the lamina of about half the area of the hexagon. He also noticed teeth projecting from the hexagon sides upon the upper (outer) lamina, giving, in one position of the objective, the appearance of a row of circular dots around the margin of the areolæ. In only one respect would I differ from his principal conclusions. He thought the "eye-spots" open at their centre. Examining the valve as an opaque object with the vertical illuminator and a high power, it will be seen that the film is unbroken, and completely closes the cell in this case as in *Triceratium*. Near the centre of the eye-spot it is so thin that it cannot be easily detected by transmitted light, and might readily be supposed to be wanting.

Where the outer lamina (on the

convex surface of the valve) meets the hexagon walls, little costæ or angle-ribs run down from the walls and extend upon the face of the film, like minute buttresses. These are not found in all specimens of the shell but only in the larger ones. In such a slide as Petcolas' diatoms from Calvert Co., Md., a majority of the valves of this diatom show this feature. The bases of the angle-ribs run into each other making a semi-circular outline, which by repetition makes a scalloped margin, the points pointing inward. This, when the objective is a little out of focus, gives the appearance of a circlet of dots. I have, however, found some examples of very large shells in which the whole surface of the hexagon is covered with dots as in *T. favus*. The tendency to support by costæ a thin film covering an areola, in the manner described, is not confined to *Coscinodiscus*. I have in another place (*Am. Journ. Micr.*, vol. iii, p. 127) noticed the same in *Isthmia nervosa*, and it will be found in other genera also.

Another fact in the variation of *Coscinodiscus* is important. In both the Calvert County and the Nottingham deposits a great many valves will be found in which the hexagonal areolation is not complete. On one edge of the shell it will be found that the areolæ have diminished in size, changing from hexagons to circles, and leaving a considerable hyaline space between, instead of being bounded by the common hexagon walls.

Those who may have access to the series of photographs of diatoms made by Dr. Woodward at the Army Medical Museum, will find among them a splendid picture of such a shell. This defect in areolation is usually on one segment of the valve, and the contrast is like that of soap bubbles crowded together in one place and separated in another, as seen in experiments in the laboratory upon the tension of elastic films, which may possibly be more closely related



to our subject than by mere similarity of form. My present use for such examples, however, is as types of the appearance of circular areolæ in silicious films. As there is no dispute that the hexagons are true areolæ, there can be as little that these circles in the same valve are such. It is well, therefore, to observe them with different powers, and to get with low objectives their appearance under similar apparent magnification to that which the finer dots will have under high powers. With a good glass at best adjustment the margin of the areolæ will be sharply defined, the thicker part of the shell will be of a delicate pink color, and the light in the centre of the areolæ a greenish white which corresponds closely with the color of the empty part of the field. It is worth while to spend some time in making these appearances familiar; for by studying them both when beyond and when within the focus, we shall get a good test of the way in which circular areolæ behave, by which we may judge of other much smaller dots which we shall have occasion to examine.

(To be continued.)

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### A New Method of Mounting Hydra.

Who that has seen the beautiful *Hydra viridis* gracefully waving its delicate tentacles, while swaying from a rootlet of *Lemna* or a filament of *Vaucheria*, has not wished to permanently preserve the pretty zoophyte thus expanded? The ardent microscopist will probably have found the accomplishment of this to be no easy matter, for *Hydra* has an aggravating way of dying only when retracted into a dumpy little lump, studded with stubby knobs where a moment before the long arms were waving from a slender body. I have spent many an hour in endeavoring to devise some plan by which this interesting little polype could be killed so quickly as not to give it time to contract. The various fixing fluids which have been

from time to time recommended, such as osmic, pyroligneous and picro-sulphuric acids, were duly tried, as was also the method of gradually stupefying the animal with small successive doses of alcohol; but the results in each case were far from being satisfactory. At last the following simple process was hit upon, which has accomplished the desired end more perfectly than any I have seen published:—

Have in readiness a slide upon which a well-dried cell of sufficient depth has been turned. Then, from a gathering of hydra, transfer a sufficient number of individuals (the more fully developed the better) very carefully by means of a camel's-hair brush or a pipette to a drop of water spread near the end of a plain glass slide, and place the latter upon a table in such a way that the end with the drop projects about two inches over the edge. This is easily done by placing a weight upon the opposite end. After allowing the slide to remain perfectly undisturbed for three or four minutes, hold a lighted coal-oil lamp so that the top of its chimney is very near the slide, but a trifle above it. The hydras will then appear brightly illuminated, and it can be easily determined by the unaided eye whether or not their tentacles are fully extended. If they are, quickly move the lamp directly under the drop, with the top of the chimney about an inch beneath the slide, and hold it in that position for about 3-5 seconds, the exact time depending principally upon the intensity of the heat. Then quickly remove the slide, and place it upon a slab of marble or metal. When cool pour the drop containing the zoophytes into the prepared cell on the slide which has been held in readiness; add a drop or two of a suitable preservative fluid, arrange the little animals, if necessary, by means of a needle or camel's-hair brush (using very great care, however, as the tentacles will be destroyed by the least rough handling),

cover with thin glass, and finish as in the case of any fluid mount.

If the foregoing directions are carefully followed, and the completed slide be examined with paraboloid or spot-lens illumination, as well as with ordinary transmitted light, I think the observer will be well pleased with the result. The process seems to succeed peculiarly well with the brown hydra (*H. Vulgaris*).

I am inclined to think that with certain modifications the use of this "hot-water cure" may be given a more extended application, and I should be pleased to learn of any successful attempts in such direction.

A. H. BRECKENFELD.

SAN FRANCISCO, Cal.

### Notes on Stentor Cœruleus, or the Blue Stentor.

In studying the infusoria that abound in the small lakes in this vicinity, I have occasionally noticed several individuals of the stentor family, and have been somewhat puzzled to account for the presence inside of some of the blue stentors (*S. Cœruleus*, Ehr.) of other infusoria of comparatively large size, plainly seen through the beautiful transparent ectosarc, which resembles a blue lace bag with a fringe of cilia around the large end. My attention was attracted more particularly to this infusorian by once seeing a stentor with a large *Noteus quadricornus* inside; but, not being satisfied whether the noteus was inside or outside, and knowing how easy it is to be mistaken, I watched the creature long in its graceful wanderings to and fro in its now limited world under the lens. In course of time the tiny watery world began to evaporate, and the beautiful blue swimmer and his countless companions found themselves becoming nearer neighbors, and the stentor stopped to take in the state of affairs, and so afforded me a good opportunity by focussing to determine that the noteus was indeed inside. Soon

afterwards the stentor voided an empty carapace, a dead, cleaned-out shell, and went on his way, doubtless rejoicing at his sumptuous repast. My eyes being weary, I took a last look at my blue pet who had given me an evening's instruction and amusement, still puzzled to account for the presence of the noteus in the stentor. The question was, How did the noteus get through that beautifully made oral aperture, fringed with its delicate waving cilia, without tearing it all to pieces? Last summer, having snatched a few moments from the busy cares of every-day life, I sought out the home of the stentors, and, arriving at their secluded spot, and taking a dip with a small tin spoon, I found on examining the material with a common pocket lens that the water was quite blue with countless myriads of stentors. Filling a small bottle, I hastened home to study them in all their glory, for I have not been able to keep them for any length of time. Upon further examination I found *Rotifer vulgaris*, *Paramecium aurelia*, *Coleps hirtus*, and many smaller infusoria in great abundance, upon which the stentors had been feeding quite freely, for the rotifers and paramecia were plainly visible inside—the rotifers in a contracted state and surrounded by a transparent envelope. After watching the oral aperture in vain for some considerable time, I could not discern that a single rotifer or paramecium passed in that way; but at last I saw one of the stentors with a rotifer in close proximity, surrounded by the above-mentioned transparent envelope, and after careful observation I have come to the conclusion that the blue stentor not only takes small food particles through the oral aperture, but that it has the means of projecting portions of its protoplasm to serve the purpose of capturing its prey, for the rotifers and paramecia under consideration were slowly drawn into the body, still surrounded by a transparent envelope, and were gradually absorbed.



Sometimes two or more rotifers were seen together in the same stentor, undergoing absorption. All movements of the prey ceased when caught by the Rhyopod-like extension of the stentor, who did not seem at all inconvenienced by the presence of his neighbors within, but kept up its graceful wanderings to and fro as at first. Now, if any of the readers of the JOURNAL who are studying the infusoria of other localities have anything that will throw any light upon the subject, I would be thankful for the benefit of their experience. I have looked through Carpenter's, Kent's, and other smaller works, but the subject is not mentioned, except the taking food particles through the oral aperture brought there by the action of the constantly-waving cilia. Nothing is said about the stentor having the power of extending its protoplasm for the capture of larger prey.

J. W.

MINNEAPOLIS, Minn.

### Microscopical Technic.

#### II. MOUNTING IN GENERAL.

Before describing the processes of mounting, it is advisable to give a brief account of the different methods employed, and to offer a few suggestions intended to aid the novice in selecting the proper method for whatever specimen he may wish to preserve.

If any thin, transparent specimen, such as a piece of feather, fibres of cotton or wool, for example, be placed under the microscope and examined while dry, and portions be then examined successively in water, glycerin, and spirits of turpentine, it will be observed that the successive media cause the fibres to appear clearer and more transparent as we pass from one to the other in the order named. On seeking for the explanation of this fact, it will be found that as the light-refracting power of the liquid increases, the objects immersed in it seem to become more and more trans-

parent. When we look at a transparent object with the microscope, throwing the light upon it and through it from the mirror below in the usual way, the visibility of the object is determined by the refractive power of the object, as compared with that of the medium by which it is surrounded. When the difference in refractive power is considerable the object is distinctly seen. When the difference is slight the object becomes almost invisible. If a piece of glass be plunged into a bottle of Canada balsam, it becomes almost lost to sight, because balsam and glass refract light almost equally. In water it is somewhat more visible, but still not so distinctly as in air. Advantage is taken of these facts in mounting microscopic objects, and it will readily be inferred that the appearance of an object will depend greatly upon the method of its preparation.

Besides affecting the visibility of an object, depending upon its refractive power, the mounting medium often affects the appearance of the object in another way, by making it more transparent. This it does by filling up the pores and interstices with a medium that is transparent and of a refractive power somewhat greater than air. A piece of thin paper or a thin shaving of wood is translucent, but water or oil will make either of them almost transparent. A longitudinal splinter of a match cut as thin as possible with a pen-knife is an excellent specimen to experiment with to observe different effects in mounting. If the splinter be placed on a slip with water and a thin cover-glass applied, it is probable that the beauty of the specimen will be greatly marred by numerous minute circles with comparatively thick and black borders distributed here and there. In some places the woody structure will be clear and transparent; in others it will be filled with black lines, more or less discontinuous. All the black portions are caused by air, either in bubbles or

filling the channels or tubules in the wood. It is obvious that the air must be removed in some way. This can easily be effected by boiling the wood in water. It will then be seen that the water has filled up the pores of the wood and made it transparent. If the same piece of wood be placed in glycerin and then examined, it will appear still clearer. Another piece may be placed in turpentine, and then covered with balsam on a slide to make a further comparison.

If a piece of ground glass be examined with a microscope, the surface will appear very rough. A layer of Canada balsam will cause the roughness to disappear, because the particles that caused the rough appearance are now optically continuous, and the light passes without interruption through the glass into the balsam and to the eye. In grinding sections of hard substances, it is usual to polish the surfaces intended for examination, but polishing is not always necessary if the surface be covered with balsam, for the scratches are then invisible.

A few such observations as are mentioned above will be invaluable to the beginner in microscopical mounting. They will teach him to select the proper media for mounting his specimens, which many persons only learn after much waste of time and material.

We shall describe the methods of mounting under four heads: 1. Dry mounting. 2. Mounting in gelatinous media. 3. Mounting in resinous media. 4. Mounting in fluids.

As a rule, dry mounts are to be used with light condensed upon them from above the stage. When objects are mounted to be examined by light transmitted through them, as transparent objects, they are seldom examined in any other way. Occasionally, however, such specimens are examined with light condensed upon them from above, and some very beautiful preparations of this kind can be made, as will be learned from a future article.

We have already several times spoken of the beauty of specimens rather than of their interest in a scientific sense. It may be asked whether it be a principal aim of the microscopist to prepare beautiful objects. Some persons may say there has been too much of such work done by microscopists already; the time could be far more profitably spent in research. We may regret that there is not more thorough scientific work in progress among the microscopists of the country, but we would not, therefore, despise the work of those who, without the intimate knowledge of the biologist and the specialist in science, find pleasure in the world of rare beauty revealed by the microscope. Theirs is a study of nature, not deep, not fully appreciative, but good, elevating, educating. Therefore it is worthy of encouragement. The preparation of a beautiful microscopic specimen is worthy of emulation, even though it be only that one may have something beautiful to show to one's friends. Whatever is beautiful exerts an influence tending to elevate all who are able to appreciate it.

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### New Eye-piece Micrometer.

Prof. W. A. Rogers, of Harvard Observatory, has again laid microscopists under obligation by making an eye-piece micrometer for high oculars. It is a cover-glass of proper size to fit above the diaphragm of a  $\frac{1}{2}$ -inch or  $\frac{3}{8}$ -inch ocular, ruled in a scale with the fifth and tenth lines longer, and so fine as to need the magnifying power of the eye-lenses to separate the lines well. The high-power ocular separates also the striæ of diatoms, or other minute subdivisions of objects, and the scale enables one to count them with a readiness and ease which has not before been possible. It is a simple and inexpensive thing that takes the place of the most expensive spider-web micrometers.

J. D. C.



## EDITORIAL.

**Publisher's Notices.**—All communications, remittances, exchanges, etc., should be addressed to the Editor, P. O. Box 630, Washington, D. C.

Remittances should be made by postal notes, money orders, or by money sent in registered letters. Drafts should be made payable in Washington, New York, Boston, or Philadelphia.

Subscription-price before April 1st, \$1 per year, in advance. All subscriptions after this month begin with the January number. After April 1st the subscription-price will be \$1.50.

The regular receipt of the JOURNAL will be an acknowledgment of payment.

**SPECIAL NOTICE.**—We would call special attention to the fact that this month is the last during which subscriptions for the current year will be received at one dollar. After the first of April no orders will be taken for less than one dollar and a half.

**COLLECTING SPECIMENS.**—Mr. J. Levick, President of the Birmingham Natural History and Microscopical Society, in his presidential address, recently delivered, described a method of collecting microscopic objects which is somewhat novel. He uses a net and a small copper grapnel or four-pronged hook, which he throws out fifty or sixty yards into a pond, and draws in by means of a strong plaited cotton or flaxen line. The grapnel is made of soft copper wire, known as No. 9, B. W. G., cast together with solder. If the hook catches upon any obstacle, the line is strong enough to straighten the soft wire, and thus bring it ashore. The net is of fine French canvas, or, for the more minute specimens, a finer muslin net is used.

Mr. Levick claims great results from the use of such an apparatus. The net, passing through such a distance in the water, is likely to collect something even from waters where but little life is found.

Mr. Levick recommends a garden pond instead of indoor aquaria for those who wish to study microscopic life. He has one 8 feet in diameter, 2 feet 6 inches deep, with a good slope inside. It is made of brick, lined with asphalt, and stands 18 inches above the level of the ground.

The water can be replenished if necessary, but thus far the supply has been maintained by the rain-fall.

**POSTAL-CLUB BOXES.**—Box R came into this circuit February 4th, with only four slides.

No. 1. Mica, containing crystals of hematite. H. B. Hargreaves.

No. 2. A parasitic wasp. Rev. J. L. Zabriskie. Neatly mounted without pressure in a cell made of white wax, sealed with shellac, and finished with white zinc cement. We should think this plan would insure good cells. This one has a bubble in it, but that may have been purposely left by the preparer.

No. 3. Section of stem of fossil crinoid. Dr. F. L. Bardeen. The preparer rightly declares that the section is "too thick." The concentrated radiance of an electric light would not penetrate it, nor reveal the hidden beauties of its structure.

No. 5. Deposit from urine from a horse. Geo. C. Faville. This may prove of interest to medical gentlemen.

**THE STRUCTURE OF DIATOMS.**—The readers of this JOURNAL are aware that Messrs. W. Prinz and E. Van Ermengem have been for some time engaged in the study of sections of diatoms, with the view to elucidate the structure of the frustules. The question has long been debated among microscopists whether the punctate appearance of certain diatoms is due to elevations or depressions on the surface of the frustules. Another question has also arisen, whether the silicious coverings of the diatoms are continuous or perforated with minute apertures. In the last edition of Dr. Carpenter's book, "Revelations of the Microscope," will be found a good summary of the various arguments and experiments relating to the subject up to the time the book was written. Since then there have been several articles published in these columns about the more

recent observations of the gentlemen named above, and we have recently received a pamphlet of seventy-three pages and four plates, taken from the *Annales de la Soc. belge de Micr.*, which presents the results of their work in a complete form.

The diatoms studied were principally those of the cement stone from Jutland, which is a calcareous rock containing an abundance of organic remains—diatoms, protozoa, etc. It also contains some pyrites, which is occasionally deposited within the frustules, and assists in the elucidation of their structure.

The stone is carefully selected, and sections are ground exceedingly thin for examination. The diatoms are found to be disposed in layers, which enable the sections to be made in the desired direction with reference to the frustules. By making the sections parallel with the stratification, sections more or less inclined to the plane of the frustules, or parallel to it, are obtained. Sections at right angles give what are termed normal sections. The sections were mounted in the usual manner, in balsam, or in some cases they were first decalcified and isolated.

The structure of *Coscinodiscus oculus Iridis* has long been the subject of discussion. Mr. J. W. Stephenson found that the silicious frustule consisted of two layers, which could be separated, both apparently perforated. The study of the sections carried out by Messrs. Prinz and Van Ermengem fully sustains this view, showing in the centre of each of the hexagonal areoles a minute pore at the bottom of a depression. Mr. Stephenson's conclusions were based upon the study of the appearances of the frustules when mounted in different media. It is interesting to find them verified by a totally different and apparently a conclusive method of examination.

Diatoms coated or filled with pyrites from the London clay were also studied, and they have materially aided

the progress of the investigation. In alluding to these, we are reminded of an amusing story about them. It was, and we believe still is, a difficult matter to obtain good specimens of the London clay diatoms, which are so perfectly coated with the pyrites that they have a beautiful appearance, like polished gold, under the microscope. Mr. A. C. Cole mounted a few of them, and some sceptical individual in London accused him of "electrotyping" the diatoms! However, Messrs. Prinz and Van Ermengem have found those diatoms of great service to them in their investigations.

The investigations of these gentlemen are exceedingly meritorious, and deserve to be widely known. Unless there are some radical errors in their methods and observations, it must be regarded as an established fact that the silicious coverings of the diatoms they have studied are perforated. Accordingly, the frustules of *Coscinodiscus*, *Trinacria*, *Pinnularia*, are perforated. In another place, however, is published the first of several articles by the Hon. J. D. Cox, who has arrived at results directly contradictory to those of the authors mentioned by a totally different method of observation. The question, therefore, is still an open one, and offers an opportunity for further observation.

Supposing it to be finally decided that the frustules are perforated, it remains to be seen whether the cell-contents can be extruded through the minute apertures, as Dr. Carpenter has suggested may be possible.

As some of our readers may be disposed to repeat the observations and prepare sections of diatoms, we may here suggest a plan for imbedding the diatoms from fresh gatherings, which we intend to apply to another branch of investigation. It is to prepare an artificial calcareous rock from a mixture of finely-ground lime and clay, making a kind of hydraulic cement, with which the diatoms may be min-



gled. When this hardens, the sections may be cut, and isolated by treatment with diluted hydrochloric acid. The large *Pinnularia* is a good species to begin with.

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#### MICRO-ORGANISMS AND DISEASE.

—The *Scientific American* reprints an article from the *Sanitary Engineer* with the above heading, in which we read: "It is a shame that while these investigations are being pushed in Germany, France, and Great Britain, nothing of the sort is going on in this country." It is, rather, a shame that such assertions should be made in newspapers that ought to give more correct information. The fact is, a great deal of work is being done in this country in the investigation of the micro-organisms of disease. It is true the National Board of Health has been obliged, for want of money, to interrupt its work, which was of great value and importance, and this is to be regretted. But the readers of this JOURNAL know that observers are not idle in this country, and if the writer of the article referred to will look over the volumes of the Reports of the Department of Agriculture, he will find some of the best work that has yet been done upon diseases of animals, fully described and illustrated. It seems time that the scientific value of this work should be recognized, and if scientific men generally would come to believe that there may some good thing come out of the pages of the Reports of the Department of Agriculture, and would occasionally read those reports, their value would soon be recognized. It is a matter of regret that so much really excellent work should be allowed to go almost unrecognized by observers working in the same field.

It is also true that, while comparatively little has been published as yet by private investigators in this country, there is much work in progress, the results of which will doubtless be of great value. American observers are deeply interested in all that relates

to contagious diseases. Dr. D. E. Salmon has been working steadily upon the subject. Dr. J. C. McConnell is working on the bacillus of tubercle at the Army Medical Museum, Dr. J. H. Kidder, U. S. N., is continuing his investigations of air at the National Museum, Dr. G. M. Sternberg is constantly at work with his microscope when other duties permit, and many other names might be added to the list.

That such investigations deserve more encouragement and support from the Government no person who knows their value will deny. If the microscope could only be employed to discover the germs which cause lesions in the body politic, Congress would immediately appropriate the funds necessary for the thorough investigation of their life-history and of the best agents for their extermination.

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CHARLES STODDER.\*—Not many microscopists who have visited Boston and met there the late Charles Stodder will ever forget the enthusiastic microscopist who has been so closely associated with the later life of Mr. Tolles. Mr. Stodder was a remarkable character. He was doubtless as well known throughout the world as was Mr. Tolles, for wherever a Tolles lens was found Mr. Stodder was sure to be known. His name appears frequently in the volumes of the English and American microscopical journals, and his frequently used signature, "Carl Red-dots" is familiar to many readers. Although his contributions to scientific literature have not brought him great fame, for which he seems not to have aspired, he was a careful reader of all articles relating to improvements of the microscope. His memory was very retentive, especially relating to improvements of the microscope, and his acquaintance

\*This article was prepared for an earlier number of the JOURNAL, but the copy was mislaid and overlooked.

with the literature of the microscope implied a better knowledge of the subject than he was generally credited with.

For the past few years he has been steadily on the decline, yet we never heard him utter a word of complaint over failing health or strength. Trembling limbs and tottering steps never lessened his enthusiasm over a new lens, nor dampened his ardor to reveal the striæ on pellucida to a doubting visitor.

The infirmities of age at last overcame him, and he died in the City Hospital, on the 15th of last December, at the age of seventy-five years.

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OUR ADVERTISERS.—It is with no little satisfaction that we take occasion from time to time to make editorial mention of the firms and individuals represented on our advertising pages. Several of these have been constantly represented there since the first issue of the JOURNAL, and one of them, Mr. Woolman, has held the same entire page every month, which is the highest priced page we have. Mr. Woolman is a general dealer in microscopical goods, and can furnish any article, of whatever manufacture, that may be desired.

Taking the succeeding pages in order, the Bausch & Lomb Optical Co., doing business in Rochester, where their large and perfectly appointed manufactory is located, and also in New-York, where they have a branch office and salesroom, occupy a prominent position. Our readers may look there for the earliest announcement of the improvements and novelties introduced by them. We shall soon have occasion to refer more particularly to some of the apparatus which they have lately introduced.

Mr. W. H. Bulloch has established a good business in the manufacture of microscopes, within the last eight years. His stands are well-designed, and adapted to the wants of a large class of customers who desire good stands at a moderate price.

Mr. J. Grunow shares with Mr. Zentmayer the credit of a long-established business. His trade has been mostly with physicians, and of late years, until quite recently, his name has almost been lost to the current literature of general microscopy. He has nevertheless been constantly at work making improvements in his stands and apparatus, and he now offers a camera lucida, which was figured in these pages last year, and a form of the Abbe condenser, articles worthy of especial notice in this place.

Mr. William Wales was, for a long time, the leading maker of objectives in this country; and, indeed, at the present time he excels in the particular kind of objectives he makes, although he has allowed his competitors to go beyond him in the manufacture of lenses of great angular aperture, which have never engaged his attention. For objectives of excellent corrections and clear definition those of Mr. Wales stand equal to the best.

Mr. Pease has been advertising the "facility nose-piece" for a considerable time, and this we take to be good evidence of its popularity.

Mr. Sexton has done a good business with the apparatus manufactured by Mr. Gundlach, which we trust he may be able to continue, although ill-health, we regret to learn, has greatly troubled him of late.

Mr. F.W. McAllister, of Baltimore, who has been dealing in microscopes for a long time, has determined to give more particular attention to this branch of his business in the future. He should find a good class of customers in Baltimore, where there is a large and flourishing microscopical society, and it is to be hoped that the students and professors in the Johns Hopkins University will flock to his store for all the necessary articles for microscopical study. Mr. McAllister should find a good trade springing up in the Southern States.

The new firm of W. H. Walmsley & Co. has one of the most attractive establishments in Philadelphia for the



sale of optical goods. Mr. Walmsley is personally known to a large number of microscopists in all parts of the country—perhaps no dealer in microscopes has such an extended personal acquaintance with microscopists as Mr. Walmsley. It will be seen that the business of this firm embraces not only microscopes, but also other optical, and physical instruments, and photographic supplies.

Messrs. H. R. Spencer & Co. continue the manufacture of their justly celebrated objectives, which we have reason to believe are in constantly increasing demand. The American public is sure to appreciate articles of real excellence, for which a good price must be demanded. The Spencer objectives are not cheap, but they are good.

Mr. Zentmayer is probably the oldest established manufacturer of microscopes in the country. We need not say more than that, for permanent success in any business is only to be obtained by earnest effort, and Mr. Zentmayer has made a reputation that will endure.

Mr. Emmerich, the agent for C. Zeiss, has introduced many of the fine instruments of that famous manufacturer, into this country, where they are as well appreciated as at home,—especially the almost optically perfect object-glasses made strictly according to the calculations to Dr. E. Abbe.

In glancing over this list the reader will observe that there are few names known to microscopists not here represented. It is true that the microscope trade is not now as profitable as it has been in the past, owing to lower prices and too great competition. For this reason a few names that have appeared from time to time on these pages are now absent. We trust and believe that the times are growing better, and that those names will again be seen. Whatever temporary disturbances may arise, trade is never very long out of its normal condition. Discounts promiscuously offered have been at the root of the matter, and

such irregularities must correct themselves. The existence of a journal like this is sure to prove beneficial to every dealer and manufacturer. Subscribers should consider this and send their orders only to those dealers who recognize the fact, and express their recognition of it by occupying space upon our advertising pages, more or less according to their means and extent of business. There are not many we are pleased to observe, who are willing to reap the benefits of the existence of a microscopical journal, without giving it their constant encouragement and support.

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### NOTES.

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—A writer in *Science Gossip* in describing the eyes of spiders, the article forming one in the finely illustrated and interesting scenes entitled "Graphic Microscopy" which is now running in that journal, suggests an ingenious method of examining the eyes of living spiders. It is to make a paper cone with the apex cut off slightly smaller than the body of the spider. A vigorous spider will soon project its head through the aperture. When in this position it should be blocked behind with moist cotton, and the base of the cone then gummed to a slide.

—The *Scientific American* gives an account of an "Electric Microscope" exhibited at the Crystal Palace, which is an apparatus for projection with the microscope, using the electric light for illumination. We fail to discover any novelty about the apparatus, for the electric light has been used for the purpose before,—never, however, with very satisfactory results, owing to the unsteadiness of the light. If the electric light could be made steady enough for the purpose, such exhibitions would become very popular no doubt—but changes in the optical appliances must be introduced before satisfactory results can be obtained in any way. There is no doubt great improvements can be made in this respect, and we hope soon to be able to make some experiments in this direction, of which our readers shall be duly informed.

—Messrs. J. W. Queen & Co. have called our attention to a statement on page 227 of the preceding volume, which they

consider misleading. Messrs. Queen & Co. desire it to be known that they have been, and are still, the sole American agents for Mr. Crouch since the year 1877.

—There is a prevailing notion among unscientific people, which occasionally shows itself among those who would naturally be expected to know better, that the air of sick-rooms carrying the germs of contagious diseases can be purified by contaminating it still more with the odors of carbolic acid, chlorine, and various other disinfectants. No microscopist would fall into such an error, but it has been quite generally assumed by surgeons that the carbolic spray, so frequently employed in operations, was a great, if not an absolute, protection against atmospheric germs finding their way to the exposed tissues. It appears, however, that the spray has no protective influence whatever, so far as killing the germs is concerned, for vessels of putrescible liquids exposed to the air under the carbolic spray, soon become putrid from the atmospheric germs. The most rational method of protecting exposed surfaces, therefore, is to allow free access of air through a filter of cotton, which effectually prevents the passage of germs.

—A microscopical society has recently been formed in Washington, which has held three meetings. It comprises about fifteen members, but this number will soon be considerably increased. Dr. E. M. Schaeffer is the President and Prof. W. H. Seaman the Secretary.

—Mr. Rockwood, the celebrated photographer, has made some experiments with a new form of telephone, in which there is a fine pointed wire attached to one side of the vibrating diaphragm or tympanum. As the plate vibrates to the voice the point alternately approaches and recedes from a pointed conducting wire. To record the motion of the point, which is necessarily too rapid and slight to be seen, Mr. Rockwood has photographed it, using the light of the electric spark to get instantaneous exposures. The result, according to the *Photographic Times*, was very successful, as a microscopical examination of the negatives showed the vibrations of the point. The duration of the electric spark is so exceedingly short, being stated as  $\frac{1}{10000}$  of a second, that it seems hardly credible that photographic plates could be made sensitive enough to take an impression in that short time.

## CORRESPONDENCE.

American Society of Microscopists.

TO THE EDITOR:—Will you allow me through your JOURNAL to announce to the American Society of Microscopists that the Executive Committee has appointed the next annual meeting at Rochester, N. Y., commencing Tuesday, August 19th, 1884. Circulars giving general information will be issued in due time, both by the officers of the Society and by the local committee.

D. S. KELLICOTT, *Secretary*.

BUFFALO, N. Y., March 3d, 1884.

—O—  
The 'Congress' Nose-piece.

TO THE EDITOR: In reply to Prof. McCalla's letter in reference to the "congress" nose-piece, I would say I have always given him the credit of suggesting the idea; but it is one thing to suggest an idea and another to put into practical shape. Prof. McCalla claims to have drawings and sketches of a nose-piece invented three years ago, and to have exhibited them to myself and several others at the Detroit meeting. As I can only answer for myself, he never showed any drawings to me, or in my presence, there, or at any other time. As I did not hear his address in Chicago, having other matters to attend to, I did not know anything about his reference to a nose-piece until one or two days after he read his address. In the *Proceedings* of the A. S. M., page 16, he is reported to have said: "Mr. Bulloch promises to have some specimens of this form ready to show at our next meeting."

The above remarks should not have been printed in the *Proceedings* of the Society. They are not in the official report of the meeting, as given in the *Chicago Times*, August 8th, and, as I said above, I knew nothing of his idea until one or two days after the address was delivered. Whether Prof. McCalla asked me to make a nose-piece or not I cannot say; but when we were in general conversation around the table, Mr. E. Bausch, Mr. E. Pennock, Dr. N. T. Lewis, and others being present, Prof. McCalla mentioned his idea about a bayonet-catch nose-piece, and I said: "I understand what is wanted; will work it out, and have one that can be shown at the next meeting." There were some sketches made on the table, but any other drawing or sketches I have never seen. If he desired me to make a nose-piece according



to his idea, it was not at all necessary for me to "work it out." He should have furnished the full drawing with description. He says: "After some months I made one and sent it to him, with letter, for his approval and further suggestions." The letter above referred to is dated October 30th. The meeting was from the 7th to the 10th of August, which he calls "some months." In my letter to Prof. McCalla I said: "I have just sent you by mail one of the new Congress nose-pieces, which I have perfected from the idea suggested by you. I think you will admit that it is the best one that has been brought out. I made two or three different styles before I was satisfied." Prof. McCalla's answer to the above, by postal-card, is as follows: "Yours rec'd, and the nose-piece also. Many thanks. It is quite perfect. Will write more fully next time." It is hardly reasonable to suppose that I would be wanting suggestions, when the application for patent was filed September 22d, six weeks previous to the date of the above letter, and the patent granted three days before he wrote the postal-card.

The microscopists of this country are under great obligations to Prof. McCalla for his generous contribution for the improvement of the microscope. He says that he had "perfected his idea three years ago," but he did not take the opportunity to write a description, which would not have taken ten minutes of his valuable time. He waited until I put his crude ideas into practical shape, which cost me time and money, and now claims all the credit. By his statement he says that he showed the drawings and described his invention three years ago, and some of the persons he claims to have shown them to are practical opticians; but if he did, no one thought it of any consequence, for they never saw any details, and very little of what was said can now be remembered. Two of the persons that he names in his letter to the JOURNAL say they never saw any drawings. His very liberal offer to the manufacturers of the country was thrown on barren ground. He must understand that the suggestions of improvements are not patentable, but that they must be put into practical shape either by intelligible drawings, model, or otherwise.

If I have "pirated" Prof. McCalla's "form," I certainly have not hidden my light under a bushel. I have given to the microscopic world the pirate spoils, which it might never have possessed and enjoyed had it not been for my zeal in the prose-

cution of the enterprise which had been so many years in developing, and which only "practical inventive genius" could prepare for the public good.

WALTER H. BULLOCH.

[Prof. McCalla has furnished drawings of his nose-piece which were to have been engraved for this number, but the cuts were not ready in time. They will be published next month.—ED.]

#### Cleaning Slides and Covers.

TO THE EDITOR:—Your advice no doubt is very good, but inquiries for chemicals at our country drug store, are generally met with the reply "we have not got it," besides your process requires time. Finding myself out of slides lately, and having a chance to procure some good material, I condemned a dozen of my first attempts at mounting. I put them on the warm stove, and by the time the last one was put down the first one was hot. I then slid the covers off of the slides, into some alcohol. By that time the first slide had got cold and the balsam hard again. I then scraped all the slides, and with a cloth moistened with alcohol removed every trace of balsam, fished the covers out, cleaned them without breaking one, and finished the whole operation while waiting for breakfast. I also found that by merely dipping a mounting needle in alcohol, I could capture small insects on windows very easily without injuring them; they flew on to the needle in every instance, as soon as they came under the influence of the alcohol; this may possibly be new to some readers. Moreover, both processes furnish a good anti-prohibition argument. Alcohol we are told to taste not, touch not, handle not. I am willing to subscribe to the first part of the proposition, but would advise insects to heed the second, especially when the "bug hunter" is on the war-path.

MELVIN, Ill.

F. DIENELT.

TO THE EDITOR:—If "G. T." will keep, on his work-table, or conveniently at hand, a covered vessel (such as a jelly tumbler with a glass top) containing a rather strong solution of sal-soda in water, he will find that by dropping therein his balsam-smear slides or covers, in a day or two the balsam will turn into a whitish, pasty substance that can readily be rubbed off by the fingers, leaving the glass clean and ready to be rinsed in soft water. He must not forget them, however, and let the solution dry down, as in that event his covers will be very likely be ruined

by a cloudiness that gathers on them and is indelible.

A. L. W.

—o—  
TO THE EDITOR:—Your correspondent G. T. asks for an efficient mode of "cleaning off old balsam-mounted slides and covers." In my experience I have found the following method as effectual as any: I submerge them in rectified spirits of turpentine until the balsam is dissolved; I then again submerge them in liquor potassa and finally rinse with soft water.

E. W. OWEN, M. D.

BROOKLYN, N. Y.

—o—  
TO THE EDITOR:—To clean old balsam mounts, let them stand in a saturated solution of common washing soda two or three days; the balsam will become brittle and easily rub off.

S. WELLS.

—o—  
TO THE EDITOR:—I notice your reply to G. T. about cleaning glass, and your suggestion is a good one, but not exactly what I think he needs. If an old slide is warmed and the cover pushed off, and then alcohol applied, the old balsam will be disintegrated and readily rubbed off, so that the glass will look clean, and will be clean enough for many purposes. To make it chemically clean it should be placed for twenty-four hours in alcohol and muriatic acid equal parts, and then transferred to the solution you suggest for three or four hours, and then washed under a tap and dried by standing on end. The bichromate mixture is the same as ordinarily used in a bottle battery: Two oz. bichromate of potash dissolved in twenty fluid oz. of water, and then three oz. of sulphuric acid gradually added.

A careful mounter will clean all slides before using them, even when they look clean, and he will especially see to the good condition of the cover-glass.

D. S. W.

## NOTICES OF BOOKS.

*Description of Iowa Uromyces.* By J. C. Arthur. From Bulletin Minn. Acad. Nat. Sci., Vol. XI. (Pamphlet, pp. 37.)

*Normal Condition of Cellular Structure and Peach Yellows.* By D. P. Penhalow, B. S. Houghton Farm, Experiment Department. Diseases of Plants, 1882. New-York, E. S. Dodge, Steam Printing House, 95 Chambers Street, 1883. (Pamphlet, pp. 45, and four plates.)

This is a record of experiments conducted to determine the cause of peach

yellows. The first part treats of observations on the normal condition of vegetable structure with reference to cell-contents. Numerous sections of different plants, taken at various seasons were compared, and the results summarized. With some exception it was found that the quantity of reserve starch in the cells is least during active growth, and greatest just after the fall of the leaves, and most abundant in the old and most lignified tissues. Leaves contain starch during their greatest activity, but as they ripen oil takes its place.

As regards the yellows of the peach the author does not believe it is caused by fungus, but that it is due to low vitality caused by impoverished soil. The presence of fungi is merely incidental, the low vital condition enabling them to gain foothold in the tissues. The colored plates are instructive.

### *The Recent Advances of Sanitary Science.*

The Relations of Micro-Organisms to Disease. Annual address delivered before the American Academy of Medicine, at New-York, October 10th, 1883, by Henry O. Marcy, A. M., M. D., President of the Academy, Member of the British Medical Association, Corresponding Member of the Midico-Chirurgical Society of Bologna, Italy, etc., Philadelphia, 1883. (Pamphlet, pp. 24.)

*Remarks on Hydrophobia.* Read before the Philadelphia County Medical Society, May 23, 1883, by Charles W. Dulles, M. D. Reprinted from the Philadelphia Medical Times. (Pamphlet, pp. 12.)

The author combats the idea that hydrophobia is a disease produced by a specific form of virus. He has compiled the opinions of numerous writers, and revealed a very confusing mass of testimony therefrom, which seems to bear him out in the belief that we might study the subject more advantageously if the whole mass of literature relating to it were swept away.

## Exchanges.

[Exchanges are inserted in this column without charge. They will be strictly limited to mounted objects, and material for mounting.]

Will exchange various mounts of crystals for other slides, and material for mounting.

JAMES E. WHITNEY,  
Rochester, N. Y.

Wanted—Physiological and Pathological preparations in exchange for Gorgonias, Starches, Microfungi, Vegetable Hairs, &c.

W. R. MANDEVILLE, M. D.,  
154 Canal St., New Orleans, La.



# THE AMERICAN MONTHLY MICROSCOPICAL JOURNAL

VOL. V.

WASHINGTON, D. C., APRIL, 1884.

No. 4.

## An Outline Study of Nervous Development.

BY DR. CHAS. S. DOLLEY.

It is both interesting and profitable to the microscopist, in connection with a study of structural development, to pursue a parallel study of the development of function. If, as Spencer puts it, the life of an organism depends upon a continual adjustment between internal and external relations, any change in environment necessitates a corresponding change in habit; and new habits, when retained, give rise to new tissue specializations. Our understanding of the history of tissue-development will be incomplete, if derived solely from the study of structure. Histology, morphology, and physiology should go hand in hand, and the evolution of function be studied simultaneously with the evolution of form. It is the early stage of nervous development which especially needs elucidation. When once the evolution of nerve-fibres and cells and their arrangement into simple reflex mechanisms is explained and understood, the history of the development of compound nervous systems may be readily comprehended, and traced through progressive series of centralizations.

Life implies sensation; general innate sensibility is a necessary attribute of all living matter; it exists independent of a nervous system or any trace of nerve elements.

It is this lowest form of sensibility that indicates to the animated organism changes inherent or excited upon it, without perception of the object exciting; it is necessary to the existence of all other particular sensations,

and is the direct result of vital action. From this 'obscure, original, innate sensation' arises common sensation, called *cænæsthesis*, by which those bodily conditions are revealed to the organism which have their seat in the vegetative life. These states are bodily heaviness or buoyancy, atony or tonicity, hunger, thirst, sexual instincts, etc. By the celebrated Sweed of Upsal, sensibility was considered as the characteristic attribute of animals, and his successors have, in imitation of him, seen in the existence of this property the means of distinguishing between the two kingdoms of living nature, the proof of its duality. A close comparative study of nervous phenomena as exhibited by plants and animals will, however, force us to modify Linne's criterion of animality, and to concede to plants the property of sensibility, in its general sense of unconscious sentience or perception, and to find as peculiar to animals, and even then only to the more highly differentiated forms, simply a particular mode or manifestation of sensibility known as reflection, attention, or thought. All physis acts involve nerve action, but the proposition is not reciprocally true. As evidence of this, and to prove the existence of an innate corporeal sensibility in the simplest forms of life both animal and vegetal, as well as the fact that certain functions generally supposed to be dependent upon a nervous and muscular system may be independent of any specialized tissue, we will glance at instances which have been noted by some of the most trustworthy of scientific observers. While the phenomena described evince discrimination

and design on the part of plant and animal, they do not necessarily imply any psychic process, and there is no evidence to show that the organisms exhibiting them are aware of the design; in other words, there is no consciousness, in a psychic sense. The lowest or most restricted form of sensation is, however, inseparable from knowledge in its essence, which implies discrimination of difference or agreement. Engelmann describes how the fluent jelly of the so-called 'flowers of tan' (*Æthelium septicum*), while creeping about upon the spent tan bark, will draw itself into the deeper parts upon being suddenly exposed to the irritation of bright light; likewise, how the great freshwater amoeba-like organism *Pelomyxa palustris* creeps about quite vigorously in the dark, but upon being suddenly illuminated it will within a few seconds assume a spherical shape, the granular streaming having previously ceased. Every student of plant histology knows how extremely sensitive to mechanical irritation of any kind are the protoplasmic threads and currents of plant-cells; the freshly-made preparations showing only motionless protoplasm, which resumes its activity after the preparation has had a period of rest.

The selenotropic and heliotropic movements of plants, as well as the so-called 'movements of irritability' in plants recognized as 'sensitive,' and also in those not generally supposed to possess this property, all go to make up a mass of evidence to prove the existence of a fundamental sensitivity both phototropic and mechanical in all living organic matter. America's most eminent microscopist has pointed out how that mere jelly-speck, the rhizopod, moves about with the apparent purposes of more complex creatures; evidently possessing a power of discrimination and selection of its food, since it commonly rejects dead diatom shells and the empty cells of other algæ. Darwin, on the other hand, has shown how

the sundew will always seize upon substances of an organic nature, while inorganic matter, such as glass, chalk, stone, or metallic substances, will be rejected, the highly sensitive glandular hairs making little or no movement towards the particles placed upon the leaf, and, notwithstanding the highly nervous temperament of the leaves, cutting or pinching them causes no movement, and gusts of wind or drops of rain are without effect. The microscopist, therefore, whether using his instrument or not, has presented to him an unconscious, organic discrimination of impressions, followed by purposive movements, which must lead him to conclude that all animal and most plant actions are the result of sensibility.

Motion is an essential condition of life, and Aristotle traced all motion to impulses rising, in the nature of things, from the common sensibilities of life. Motility and sensibility are correlative properties, inseparable from one another. We speak improperly of the 'spontaneous movements' of protoplasm. There is no spontaneity in life, either in its genesis or its functions. Movement is determined by the influence of an agent; this agent is the excitant. The property of reaction after excitation, as indicated by mechanical, neural, or psychic manifestations, is irritability. Some have regarded irritability as an elementary form of sensibility, sensibility an exalted expression of irritability. Chemistry throws no light upon the functions or development of nervous matter, and the microscope shows us that the matter immediately concerned in nervous manifestations is, in the highest forms, composed of the same colorless, moving substance which constitutes the living matter of the lowest organisms. The protoplasm of the lower forms of life and the ganglionic tissue of higher forms are similar. Sensibility is a property inherent in both. Nerves are but specialized pseudopodia adapted to conveying excitation from one ganglion to an-



other, and if we study the cells and fibres in the ganglia of the lowest and highest orders we will still encounter the same fundamental constituents of structure. Our conclusion must therefore be that nervous phenomena are not due, as Sylvius taught, to the chemical composition of, or processes taking place in, the body-substance, nor to thermo-electric currents set up by differences of temperature between the interior and surface of living bodies, as Garrod suggests, but to an unstable molecular balance, or arrangement, peculiar to living matter, constituting irritability or sensibility, general at first, specialized later. This theory is one of vital mechanics, innervation being a motor process, arising through definite external processes, the nerve stimuli. Spencer terms the ganglion cell a 'libero-motor element,' and since we recognize nervous phenomena only in living matter, and in all living matter, and as the principle of the conservation of energy has to do only with motor forces, it would seem to sustain Le Conte's theory that vitality is more than a principle, that it is a force correlated with and derived from the physical and chemical forces, the soul being, like Peter Schlemiehl's, an example of 'polarized activity.' The power of continually adjusting internal with external relations depends upon experience, and experience depends upon memory. We must therefore consider one of the chief factors in the history of nervous development to be that premial nervous capacity of living matter for retaining impressions of inherent or excited changes spoken of as 'organic memory,' which gives rise to all that class of movements called secondary, automatic, or acquired. By means of this organic or unconscious memory, not only the characteristic peculiarities of an organism are carried over from one generation to another, but new experiences acquired through adaptation to changes of environment are retained.

Irritability or sensibility is the power of formative material to perceive and react to external changes. Organic memory is the faculty which enables form elements to profit by, and adapt themselves to, frequently-recurring changes. Haeckel puts it thus: 'In the very simple and persistent forms of life, the plastidules have, so to speak, learned nothing and forgotten nothing. In the highly perfected and variable organisms the plastidules have both learned and forgotten much.' They have become possessed of what Carpenter has called 'potential knowledge.' From the foregoing it is evident that the protozoans or single-celled animals, as they pass over into the class of metazoans or many-celled, bring with them a heritage of nervous capacity, each morphological element of the compound body contributing a limited power of conducting or storing up nervous energy. Among metazoans those dim sensations common in varying degrees to all actively living matter constituting *cænæsthesis*, are transformed into the delicate perceptions of the higher animals. The quality of the sensation depends upon the capacity of the specialized tissue for facilitating the flow of nervous influence; the more elaborate the differentiation, the higher the grade of consciousness. 'A single individual metazoan being equivalent to a number of protozoa coalesced to form a single organism in a higher state of aggregation,' it becomes necessary that impressions received by one portion of the compound body be imparted to other portions, and since some parts are more exposed to external impressions than others, the nervous disturbance will radiate more frequently along certain lines. Again, some portions of the surface being exposed more frequently than others to peculiar forms of irritation, certain lines will gain special facility in transmitting these impressions, and as a result the physiologist finds that the bulk of the *vis nervosa* is delegated

to certain portions of the body-substance, and there is actually a system of definite paths formed throughout the body, along which are carried the nervous vibrations. That there are, in all low forms, systems of paths of this kind which, while they are not to be detected by optical or chemical methods are virtually nerves, is evident from numerous observations of the action of multicellular organisms towards various forms of stimuli. For a considerable time these tracts may act vicariously, as was shown by Romanes' experiments upon medusæ, but gradually they not only assume a definite structure visible to the microscopist, but they lose their sensibility to certain impressions, and are capable of responding only to that form of irritation to which they are most often subjected. Thus, from the deposit of pigment in patches upon the surface, certain points become more readily sensitive to light, and we have developed the rudiments of visual organs. From the fact that the organism moves habitually with a certain portion of its body in advance, and this habit is seen even in the amœba, this portion would be more repeatedly brought into contact with foreign bodies, and would gradually develop a more delicate tactile sense than other parts.

Gradually the variously specialized portions of the body become grouped and centralized, and we see those elements mostly in the surface layers, which have developed more than others, their nervous heritage forming connected groups, portions of which monopolize the receptive power while others are adapted for the transmission of the molecular disturbance created at the receptive point.

As the acquisitions of organic memory become more and more abundant some groups of nerve-elements lying at the cross-roads of nervous communication develop their power of retaining impressions beyond that of other groups, and we have formed a *sensorium commune* of some sort or other, 'a nervous centre to which mediately

or immediately,' as Spencer says, 'the most heterogeneous impressions are brought.' Beginning with undifferentiated protoplasm, Mr. Spencer in his 'Principles of Psychology' announced *a priori*, and elaborated deductively, a theory of neuro-genesis, which has been found to accord with the observations of microscopists and embryologists. Through the labors of such men as the Hertwigs, Eimer, Claus, Schafer, Hubrecht, and Kleinenberg, it is demonstrated that the nervous system of the higher animals has been gradually evolved by the differentiation of the superficial cells of the body. These cells, uniting by their processes, produced at first a superficial nervous network, forming, as we have seen, specialized groups or sense organs, and gradually travelling inward to give rise to the central nervous system.

There remain, however, many questions of interest for our microscopists to settle, and the labor annually devoted to arranging diatoms and making beautiful mounts of miscellaneous objects would, if concentrated upon these moot points, not only give invaluable results to this branch of organogeny, but tend to place American microscopists more on a level with those of Europe.

### Prof. McCalla's Nose-piece.

The controversy that has arisen between Prof. Albert McCalla and Mr. W. H. Bulloch concerning the invention of the 'congress' nose-piece, has made it desirable to present copies of the original drawings as furnished by Prof. McCalla some time ago. The description is given by Prof. McCalla as follows:—

'The objective is armed with a ring (fig. 13) to screw on its upper end, having three lugs or pins placed equidistant around its circumference projecting horizontally. The nose-piece itself consists of an inner fixed tube

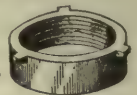


FIG. 13.



(fig. 14) having three straight slots to receive the lugs before mentioned, and an outer tube or ring free to revolve through a limited arc around the inner tube, but prevented from slipping up or down, and



FIG. 14.

having three L-shaped slots. When this ring (fig. 15) is turned so that its slots coincide with those of the inner tube, the objective can be easily slipped up to its place. A very slight turn of the milled ring then



FIG. 15.

brings the horizontal portion of its slots under the pins of the objective, and clamps it accurately and securely. The use of the adjustment collar or any accidental touch of the objective will not loosen it or disturb it in the slightest degree, while it permits of the substitution, on the instant, of any other objective in one's whole equipment as easily as the double nose-piece permits of the exchange of one other only. The objectives not in use lie in their places in the case or drawer out of the way and out of danger of injury, instead of projecting out over the stage, a hindrance to the manipulation of the lens in use, and liable to accident in many ways.

'It will be seen that the device can easily be used with the stands and objectives now on hand, the nose-piece being made with the society screw, and separate rings provided for each objective. Its fullest advantages will be realized, however, when the society screw has been discarded entirely, and stands are made with this nose-piece after this design, and objectives having the three pins in place of the society screw, and having a diameter of say  $\frac{3}{4}$  inch or 1 inch, as may be agreed upon. This would then permit the objective to be brought close up to the binocular prism which is not possible with any form of nose-piece now in use except the ingenious device of Mr. Nelson, while it could have much the advantage of his plan in security.'

—O—

### A New Form of Stand.

The stand illustrated in fig. 16 is constructed by the Bausch & Lomb Optical Company, and designed by the Hon. J. D. Cox, F. R. M. S. It possesses some features which recommend it to the microscopist, such as great stability in all positions, and am-

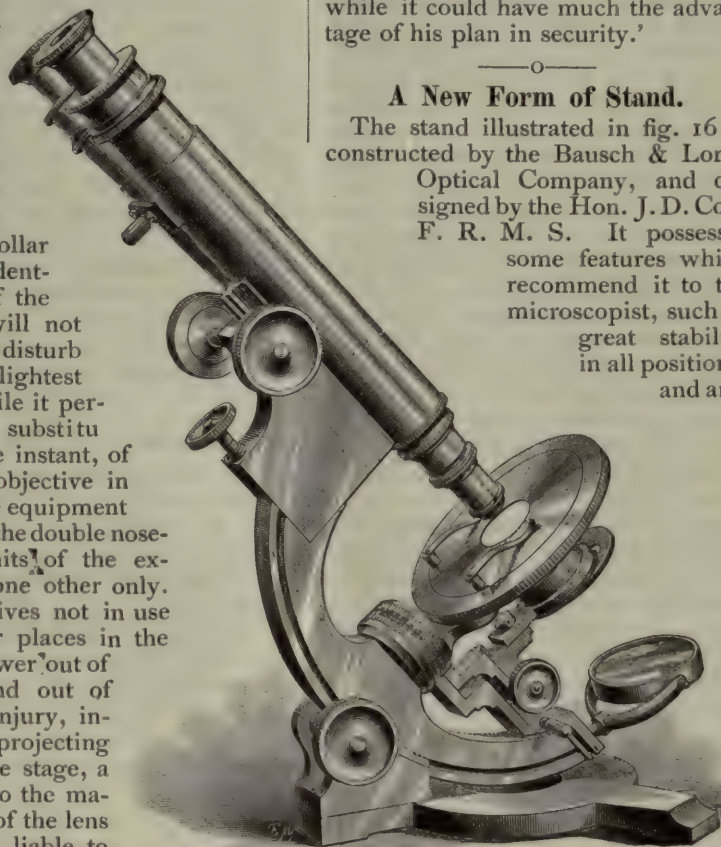
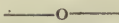


FIG. 16.—Bausch &amp; Lomb's New Microscope.

ple space beneath the stage for apparatus. It is an elaboration of the plan of Mr. George Wale, and a simplification of the more recent design of Mr. Wenham as applied in the large stand of Messrs. Ross & Co. The illustration renders a full description unnecessary. This stand will be figured in the new catalogue to be issued by Messrs. Bausch & Lomb in the course of a few months, which will also contain a number of new instruments and devices not heretofore known.



## Structure of the Diatom-shell.—II.

BY JACOB D. COX; LL. D., F. R. M. S.,  
PRES. AM. SOC. OF MICR.

When the preceding article went to the printer I had not yet had the opportunity of reading more than a synopsis of the investigations made by MM. Prinz and Van Ermenegem, of the Belgian Society of Microscopy, upon sections of the Jutland cement-stone and the diatoms contained in it. The text of their interesting papers will stimulate others to repeat their examinations and to prove the alleged advantages to be gained from their method of investigation. The doubts as to its value, which have been common among students of diatoms, have been based upon the belief that the friable character of the sedimentary rocks is such that it was hardly to be expected that sections thin enough could be successfully made, or that the extremely delicate silicious films of diatoms would withstand the grinding. A stimulus to try this field of inquiry more thoroughly is, therefore, very welcome, even if we do not find in the papers of the Belgian naturalists any conclusive evidence upon points yet unsettled.

Their investigations have been chiefly made upon *Coscinodiscus oculus iridis*, *Cosc. excentricus* (*Symbolophora Trinitatis* of the Möller type-plate), *Trinacria regina*, *Triceratium favus*, and upon allied forms found in the London clay. M. Prinz

had previously written upon the same subject, including some investigations upon sections of *Pinnularia*. Analogous work had been before attempted by MM. Flögel and Pfitzer.

So far as these investigations lead to the conclusion that the shells of these larger diatoms, having discoid or triangular forms, consist of two laminae, in the outer of which are hexagonal or circular areolae, the result is corroborative of views often expressed by investigators who have studied the subject. The point upon which MM. Prinz and Van Ermenegem regard their observations specially decisive is that the exterior lamina is wholly made up (in the diatoms with hexagonal marking) of the honeycomb structure, entirely open at the top of the alveolae, and that the interior lamina only partially closes these openings, being itself perforated by circular holes at the bottom of each of the hexagons. These holes appear to them to be bounded by a wall like a section of tube which projects a little way through the lamina both outwardly and inwardly.

This conclusion is so decisively and explicitly contradicted by the examination of these valves by other means as to increase rather than diminish our doubts of the value of sections prepared as these have been. The difference is so radical, and so easy to test, that it challenges at once the attention of all who are accustomed to the use of the microscope.

In the first of the plates which illustrate the paper by those gentlemen is a figure of the interior plate of *Coscinodiscus* showing the 'eye-spots.' These are, by measurement, more than half the diameter of the hexagons. In *Triceratium favus* the hexagons are usually four or five to the thousandth of an inch, and the 'eye-spot' or perforation should, therefore, have a diameter of at least .0001-inch. But an amplification of only a hundred diameters would make this .01-inch, and it should, therefore, be easily seen with any good



objective. As a matter of fact, the 'eye-spots' in the separated inner plate of *Coscinodiscus oculus iridis* are so easily seen with a  $\frac{1}{10}$  objective and a two-inch ocular that I am in the habit of using this glass on the double nose-piece as a 'finder' when studying that shell in the large variety found in the Nottingham and Calvert County deposits. Therefore, in an opaque preparation of this shell, or of *Triceratium favus*, since we are able not only to get an amplification of 400 or 500 diameters by the use of high oculars with the glasses named, but by using a quarter-inch with long working distance may considerably increase the magnifying power, the supposed holes in such shells are far within the limit of common observation by reflected light, and should easily be seen in such slides as Möller's opaque Cuxhaven diatoms which I have already referred to. The truth is, however, that with trifling care in the manipulation of the light the continuous surface of the inner lamina of *T. favus* may be seen with a clearness which defies all skepticism, and if the glass is a good one, there need be no great difficulty in seeing upon its surface the finer system of dots which is independent of the hexagonal marking, as in the case of *Eupodiscus argus* also. The outer lamina will also be found continuous. There is no room for illusion in this matter. Broken shells are easily found, and some with holes broken in them, and the difference between a plane surface and a solution of continuity is too plain to be doubted. The same facts will appear in examining the specimens of *Coscinodiscus* on the Cuxhaven slide, but as these are much smaller than those which occur in the Maryland deposits I have named, I prefer to use the latter as the tests in regard to this species.

Mr. Peticolas, of Richmond, Va., has mounted slides of the Nottingham earth which happen to contain a larger proportion than common of the robust forms. Upon an ordinary dry

slide of this sort one may use the vertical illuminator and immersion glasses of greatest aperture. Here also we get a view of the diatoms as opaque objects, and I can only repeat that whether the inner or the outer plate of the valve is examined, the closing of the hexagons by a film is as apparent as in examining with the naked eye a real honeycomb which the bees have capped with wax.

In this investigation we may make a combined use of reflected and transmitted light which is instructive. I was led to do this some years ago in examining some slides of diatoms from the sea mud at Savannah, Ga., in which the late Mr. Stodder found what he thought was a new species of *Coscinodiscus*, which he provisionally called *C. complexus*. When photographed the shell showed a peculiar lathe-turned marking, made up of mingled dots and triangles. It was, as I thought, essentially the same shell as *C. radiatus*, with the walls of the hexagons abnormally thickened, either by an extra deposit of silex or in some other way. As a transcript made at the time of an examination closely akin to that under consideration, I may be permitted to quote from a letter I wrote to Mr. Stodder under date of July 30th, 1879. After describing one specimen, a whole shell, I said: 'The second shell was one which you had marked with the "Maltwood" as having one of the laminae in part broken away. It fortunately turned out, also, to be with the convex side up, and enabled me to make what I must regard as an *experimentum crucis*. Its broken surface was peculiarly adapted to bring out the valuable qualities of the vertical illuminator. I first focussed on the lower lamina, where the upper was entirely removed from it. This was not quite in contact with the cover-glass, and consequently could not be seen so easily as it otherwise would have been. The refraction of the light made it appear black (as a very thin

transparent film on a black background), but the hexagonal outlines where the hexagonal walls were broken away, and the central circular areolæ were still to be seen with careful looking. I then turned to the thicker part of the shell, and here came an unlooked-for surprise. I immediately saw that there were two classes of appearances to be examined. 1st. In small patches over the surface from which the upper lamina had been removed the hexagonal walls stood up here and there like islands. These walls were evidently thickened and incrustated with a white substance apparently more porous than the silex, and this incrustation took the form of nodules at the angles of the hexagons, whilst it partly filled the hexagonal cell at the bottom, giving it a hemispherical or cup-like form. 2d. Beyond the general line marking the fracture and removal of the upper lamina, and where it was still in place, the surface was smooth and in all respects of the same appearance as the lower surface seen on the first specimen. This I repeated and re-examined till I felt sure of my observations, and that there was no illusion about it. Three classes of appearances stood there as opaque objects, too clear for question: 1st, the black, lower lamina with faint hexagonal and circular markings; 2d, the island-like portions of the hexagonal cells without the upper film, and incrustated with the white substance; and 3d, the upper lamina surface, smooth and gray, with its darker hexagonal tracing and circles within.

'But it occurred to me to add another test. Whilst the surface was still illuminated by the vertical illuminator I threw a beam of light through the achromatic condenser from the mirror below, and now had what seemed demonstrative evidence, making assurance doubly sure. The lower film was plainly seen, very thin, with shallow circular areolation, the hexagonal lines being almost invisible; the

patches of cell-structure stood out vividly, less changed than the rest; but the unbroken part of the structure with both laminæ in place, made transparent by the strong, transmitted, bluish light (the condenser had a blue moderator), showed the internal structure exactly as in the island patches, whilst the fainter red beam of light from the vertical illuminator still marked the gleam of the upper surface by reflection, and the whole structure stood revealed. By turning on and off the transmitted light from the mirror the surface view or the internal structure could be seen in turn, and the fascinating experiment was repeated again and again.'

We have not, however, exhausted the evidence which the transparent valves can give us. MM. Prinz and Van Ermengem say that the centre of the 'eye-spot,' viewed by transmitted light, never shows any film. It is true that along a broken margin of a separated inner lamina of *Coscinodiscus* the eye-spot is usually found empty; but this is not always so, and in the unbroken portions of such a plate proper attention to the correction of the objective will enable us to detect it in the robust shells found in the Nottingham earth. If it were not so it would not be strange, for the color test proves that the film is of wonderful thinness; and that it should be broken out by any force sufficient to separate the laminæ of the valve or break it across would be natural enough. If a sash made up of small panes of glass were broken in two we should hardly expect to find many whole panes sticking out of the remnants of the wooden frame. The evidence got from the examination of the shells as opaque objects, with both low powers and the vertical illuminator, would hardly be weakened by the absence of the central part of the 'eye-spots.'

In the Nottingham slides all the parts of the gigantic discs are increased in size and thickness, and upon examining the interior plate we



find within the hexagonal tracing: 1st, a narrow circle so thin as to be scarce distinguishable in color from the empty field; 2d, another narrow ring of pinkish color, evidently thicker than the last; 3d, another nearly colorless ring; and lastly a small central part of appreciably pink tint. Nearly every broken valve will give some examples of the inner lamina projecting beyond the outer, and a patient examination will soon find examples in which the fracture, passing through the eye-spot so as to break off only an outer segment of, say, one-third its area, leaves the inmost spot, the pink 'pupil' of the eye, intact. I have verified this so often as to be able to assert it categorically. In a very recent examination of the same material I found a single instance in which a crack from the interior of a valve when both laminae were in place went out through the inner plate where it projected beyond the other, and distinctly ran half way round the 'pupil' or central spot, and thence out to edge of the plate. The view by transmitted light, therefore, is consistent with and corroborates that got by reflected light.

As to the upper film, the same preparations give abundant evidence of its existence. I have already referred to the fact that we sometimes see in *Isthmia* the appearance of teeth or notches about the edge of the areolæ, which I have interpreted to be little processes or buttresses running forward from the thick walls to support the thin film of the areola. This film in such cases will also show more color in its central part, indicating that the part adjoining the wall is thinnest. These teeth have also been noticed by different observers in large specimens of *Coscinodiscus oculus iridis*, but in Peticolas's slides (what is not very common in other specimens of the Nottingham earth which I have seen) we frequently find this notching of the outer film become a circlet of large dots, twelve or more in number, and within these a fainter dotting covering the whole area of the hexagon. When seen in the whole valve this

might be attributed to some diffraction effect; but here also patience has proven the true solvent, and, after careful search among broken valves, I have found this film projecting beyond the edge of the broken walls beneath it, the larger circlet of dots being plainly marked, the inner ones very faint by central light, but showing strongly with a little obliquity of illumination. On such a valve you may focus sharply upon the dotted film, seeing nothing of the 'eye-spot' in the lamina below; then lowering the objective you pass through its veil and bring the lower plate with its large circle into plain view.

After becoming familiar with these phenomena in the magnificent shells of this deposit, it is not difficult to trace the films which close the areolæ in other smaller forms of similar species. In one or two instances I have found little pillars or spines of silex adhering to the inner lamina of the shell, as if the hexagonal walls had aborted, and the plates had been connected by these pillars in a way similar to that figured by the Belgian writers; but that this is not common is sufficiently attested by the hexagonal lines upon the inner plate as commonly found, these lines being the mark of fracture where the walls have been separated from the plate which caps them.

(To be continued.)

### Styrax and Liquidamber as Substitutes for Canada Balsam.

Dr. H. Van Heurck has published an article upon this subject in the *Bulletin de la Soc. Belge de Microscopie*, which should have been noticed in these columns some time ago. The matter has been held over to enable the Editor make some preparations with styrax, in order to supplement the observations of Dr. Van Heurck by a few of his own. Dr. Van Heurck introduces the subject with the following statement: "During the month of May,\* my friend, Prof.

\* This was in 1883.—ED.

H. L. Smith, wrote to me that he had found some new resins, of which one possessed an index of refraction of 1.63. I replied to him the same day that two products of this kind, styrax and liquidamber, had been known to me for some time, having found them during my researches upon homogeneous liquids, and I proposed to publish our results together.

"As I proposed to employ styrax exclusively for the series of which I begin the publication next month, the time has come to make known the properties of this product. Nevertheless, I would prefer to delay the publication, in order to join the name of Mr. H. L. Smith with mine.

"Up to this time I have received no response, and I therefore do not know if the products he has employed are the same as mine."

The author then refers to the use of naphthaline monobromide with a refractive index of 1.65 in the study of diatoms, adding that this substance can never come into general use owing to the difficulty of closing the cells containing it, and to its disagreeable odor.

In seeking for a natural resin which could be employed instead of the naphthaline bromide, with an index of refraction high enough for a homogeneous immersion liquid, two were discovered, styrax, from the *Liquidambar orientalis*, Mill, from Asia Minor, and the liquidamber furnished by the *Liquidambar styraciflua*, L., of North America.

Both these products have been used by Dr. Van Heurck for a considerable time, but the results were not published until the preparations had been kept long enough to test their durability.

The author believes that the mounts are much less alterable than those made with Canada balsam, which becomes resinous after some time.

Purified styrax contains a granular substance which must be removed by dissolving in chloroform and filtering the solution. The solution thus ob-

tained is used in the same manner as the solution of Canada balsam. Styrax and liquidamber are quite as easily employed as balsam, and they do not form bubbles of air on heating.

Diatoms are beautifully shown when mounted in either styrax or liquidamber, and their details are resolved with great ease. *Amphipleura pelucida*, for example, shows its striae in a very perfect manner. The author believes that styrax will supplant Canada balsam for mounting, owing to its great advantages.

It is well to expose the styrax as purchased, in a thin layer to the sun for several weeks. In this way much of its yellow color is discharged, the water it contains evaporates, and it becomes hard. It may then be dissolved in chloroform, as already described. Instead of chloroform, benzine, or a mixture of benzine and absolute alcohol, may be employed in making the solution.

Having given Dr. Van Heurck's observations, it remains to add our own experience with the styrax obtained from a druggist in Washington. The styrax, or storax, was a pasty mass of a light dirty gray color, a very unpromising material for a mounting medium. A portion was placed in a test-tube, shaken with chloroform and thrown upon a filter. The filtrate was clear, but rather deeply colored. This was used for mounting a few specimens of diatoms. It only required a few moments to prepare the small quantity of solution used in the experiments.

As regards the results, we can say that it works very much like balsam. Its value as a mounting medium for certain objects, such as diatoms for example, has not been overstated by Dr. Van Heurck. We shall use it ourselves hereafter instead of balsam for diatoms. The comparative experiments made by us have clearly demonstrated its superiority for this purpose. A fine slide of diatoms mounted in balsam by Prof. Kellicott, a pure gathering of *Stephanodiscus*



*Niagara*, was compared with some of the same diatoms from Cleveland mounted in storax. The markings were much more distinct in the last-mentioned slide. A slide was also prepared with diatoms from the Sandwich Islands, and as some of the species are very beautiful we have become quite familiar with their appearance in balsam, and there can be no question of the superiority of storax as shown by this mount. The same may be said of other mounts, not all of diatoms, for other objects were mounted at the same time. *Polycystina* for example, showed exceedingly well in the storax. We therefore commend the use of storax or styrax, as it is indifferently called, for mounting when a medium of higher refractive index than balsam is required.

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### New Mounting Media.

Professor H. L. Smith has been expending much time and labor in experimenting with various substances, searching for satisfactory media of high refractive index for the mounting of diatoms and similar objects. The desiderata at which he has aimed are: 1st, high refractive index; 2d, a substance to be used in a fluid or semi-fluid state in the process of mounting; 3d, the property of hardening on the slide so as to make a permanent mount; and 4th, a proper cement to protect it from decomposition if the material is in danger from that cause by reason of exposure to air or to immersion fluids.

Professor Smith is now assured that he has succeeded in his efforts, and has produced two media, both of combinations entirely new and heretofore unnoticed in chemistry. He has also devised a cement for rings upon the slides to protect the media, which is also new, and makes attractive mounts.

His first medium is a transparent, colorless substance in the form of a thick fluid,\* which hardens by heat

applied in the same way as in mounting in balsam. The heat expels the fluid part of the mixture, and leaves a solid which is a permanent mount, and requiring no more care in subsequent handling or packing of slides than balsam. The index of refraction of this medium, when solidified, is 2.00.

The second medium is a yellow tinted, thick fluid, similar in handling to the last, and to be used and treated in the same manner, but having an index of  $2.25 \pm$  when solidified. A perceptible brownish-yellow tint remains in this medium, similar to that of pretty old balsam which has been a little overheated. This medium would naturally be used for special examinations of particularly difficult objects, and the color is not enough to be objectionable, though the first medium, with its absolute transparency, would be preferred for more common use. Used in a fluid state, the denser medium has scarcely any color, but its refractive index is, of course, lowered a little.

In either of them the resolution of *Amphipleura pellucida* is made with surprising ease and strength, and with light of very small obliquity compared with that which has been necessary in dry or balsam mounts. In short, it gives all the results which the high refractive index would lead us to expect, and with none of the objections for cabinet use which belong to the solution of phosphorus and other mixtures.

The cement for ringing is specially devised to avoid any danger of its attacking or decomposing the mounting medium, and makes the whole a complete success. We have reason to believe that Professor Smith will soon make arrangements for putting these materials within the reach of all microscopists.

J. D. C.

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### Crystals of Arsenic.

The white arsenic of commerce is made up of crystals, but it is seldom

that a specimen can be found remarkable for the perfection of the crystalline forms. The perfect crystals of arsenic are very beautiful when seen under the microscope, and they are easily obtained. An excellent method of forming them on the glass slip is as follows:—

Select a small tube about one inch in length, and fit it in a holder made of a thin strip of copper, brass, or other metal having a hole bored through it to receive the tube. Let the mouth of the tube project slightly above the metal, and support the latter in some convenient way over a spirit-lamp or hold it in the hand. It is better to have a support.

Place a small quantity of white arsenic in the tube, and apply heat slowly until a white powder begins to collect about the mouth of the tube. Then warm a glass slip, and hold it over the top of the tube until bright, crystalline particles appear on its under surface. Then remove the lamp and let the tube cool.

If the heat has been properly regulated, beautiful crystals will be found upon the glass slip, which give a great variety of effects with different illuminations. On a dark ground the effects are very fine indeed.

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### Cleaning Polycystina.

The polycystina are found in many localities in this country, particularly in the diatomaceous rocks of Virginia and Maryland; but nowhere are their remains found in such abundance as in the rocks of the Bermudas and of the Nicobar Islands, where they form strata from one to two thousand feet in thickness.

Specimens of the Barbadoes material have been sent to a large number of subscribers, who signified their desire to obtain it, as already stated, and we now redeem the promise to describe the method of cleaning the specimens for mounting.

The material should first be boiled in a solution of washing soda, which

will partly disintegrate it. The liquor should then be poured off and the sediment washed, allowing it to settle each time before pouring off the water. It should then be treated with somewhat diluted hydrochloric acid, which, by decomposing the carbonate of lime, will cause considerable effervescence, and this will reduce the pieces still further. Wash again, and then repeat the boiling in carbonate of soda.

When it is thought the boiling has been continued long enough to complete the disintegration, wash thoroughly and then proceed to separate the polycystina from the sand and fragmentary particles, as follows:—

Put the material in a beaker, or a bottle that will hold six or eight ounces. A quinine bottle is very good for the purpose. Fill the bottle with water and thoroughly shake it. Set it on the table for thirty seconds, exactly. Then pour the fluid off into a larger bottle almost down to the small quantity of sediment that will be found at the bottom. Fill the bottle again, shake, and let it stand thirty seconds; pour off and repeat these operations until the water pours off clear. This separates all the material that will settle in thirty seconds. Transfer it to a small vial and label it.

Let the sediment deposit in the large bottle, pour away the water above it, transfer the sediment to the first bottle, fill up with water, shake, and let it stand one minute. Repeat these operations as before, and thus will be obtained the material that settles in one minute. In like manner obtain what will settle in two or three minutes.

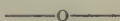
By proceeding in the systematic manner above described, a large quantity of broken particles and objectionable matter will be removed, and the polycystina will be made tolerably clean. To further clean them, take the different deposits separately, and proceed with each one as follows:—Place it in a test-tube, and boil with strong nitric acid for a moment. Then wash thoroughly. After wash-



ing away all the acid, pour on enough strong ammonia to cover the sediment. Let it remain two or three minutes, wash again, and then separate the forms by gravity as before described, using test-tubes instead of bottles.

If these operations are conducted as we have described them, a clean collection of the beautiful skeletons will be obtained, from which fine mounts can be made. The methods of mounting will be given in the course of the articles on Microscopical Technic.

The method above described is intended for those who wish to obtain only the finest and most striking forms. For the student of the radiolaria who would desire to keep the more delicate forms as well as the others, the treatment should be somewhat modified, and the disintegration of the rock would be more gradually effected.



### Microscopical Technic.

#### III. MOUNTING OBJECTS DRY.

By far the greater number of objects that are mounted dry are best examined by light condensed upon them from above. Occasionally very thin and transparent specimens, such as diatoms, foraminifera and radiolaria, spicules, thin sections of plant stems, cuticles, leaves, etc., are mounted dry for transmitted light. A thin section of elder pith, for example, mounted dry and illuminated with a paraboloid, makes a fine object; but generally such specimens are seen better when immersed in a medium like Canada balsam.

We shall select for description such specimens as seem best calculated to cover the whole field of dry mounting.

*Dry Transparent Mounting.*—In describing this method of mounting, perhaps we can do no better than to follow the process of mounting diatoms. The glass slips and covers

should be selected and cleaned, and the mounting apparatus placed near at hand. Then proceed to prepare the cells, as follows: Put a slide on the turn-table, and make a ring of shellac in alcohol upon it, just large enough to support a  $\frac{1}{4}$ -inch cover-glass. Prepare a number of slides in this way, and set them aside for the shellac to harden. In twenty-four hours they are ready for use; but if there is not time to wait for spontaneous drying, heating over the spirit-lamp will harden the shellac in a few moments.

When the cells are ready the diatoms may be prepared on the cover-glass, for it is better to mount such minute specimens upon the cover-glass than upon the slide. The reason for this is that in case it should be desired to examine them with a lens of high power and short working distance, they will be nearer to the lens and more readily focussed upon if attached to the under side of the cover-glass than if on the slide itself. Moreover, there are optical reasons which make it advantageous to mount the finer diatoms in this way.

Assuming that the latter are properly cleaned, and preserved in a mixture of equal parts of alcohol and water, it is necessary to dry a very thin and evenly distributed layer upon the cover-glass. The simplest way to do this is to support the cover upon a thin piece of metal, and heat it with the spirit-lamp until all organic matter is burnt away. An excellent support can be cut from a piece of ferrotype metal, such as is used by photographers. Take an old ferrotype picture and cut out a narrow strip, about  $\frac{3}{16}$  of an inch wide, with an enlarged rounded end a trifle more than half an inch in diameter to support the cover-glass. Select a bottle of the proper height, load it with shot or sand, and thrust the small end of the support into the cork of the bottle. Put the cover-glass on the support, dip up a drop or so of the fluid containing the diatoms, and

spread it over the cover; put the lighted spirit-lamp beneath, so the flame plays directly upon the metal and causes rapid boiling, which distributes the forms well, and immediate drying; continue heating as much as the glass will bear for several minutes. During the heating prepare one of the slides by running a second coat of alcoholic shellac over the dried rings to act as a cement. Then, when the cover-glass is cool, invert it over the cell, and press it down on the fresh shellac until it is in contact all around. Set it aside for a few minutes, and then apply a third coat of shellac, running it over the edge of the cover to ensure perfect sealing of the cell. The mount is now perfectly safe, if it is not handled roughly. It may be put away until a number have accumulated to be finished together. The methods of finishing will be given further on.

It will be obvious that any transparent objects may be mounted in the same way, placing them upon the slide itself instead of upon the cover. The scales or wing-dust of moths and butterflies will afford the novice good specimens to experiment with in this kind of mounting.

#### *Mounting Thin Opaque Objects.*

—The method of preparing the cells is the same as that just described, except that the cells are made opaque inside of the shellac ring, being either wholly covered with a black, opaque varnish or paint, as is usually the case, or a central spot only is covered, leaving an annular clear space around it, as when the lieberkuhn is to be used. For this purpose asphalt is frequently used, but ivory drop black is much to be preferred, as it gives a dead black surface. We have used with much satisfaction a fine black paint manufactured by Messrs. F. W. Devoe & Co., of New-York, which dries upon glass without cracking, and gives a dead black surface. It is very useful in mounting.

The lieberkuhn is an illuminator much less used than it deserves to be. Light is thrown up from the mirror all around the opaque spot upon which the object is mounted, and is reflected down upon the object from the lieberkuhn, giving particularly fine effects. Mounting very minute objects upon small opaque spots is an excellent plan apart from its advantages for the lieberkuhn, as it makes neat slides. It is especially adapted to such specimens as the spicules of sea-fans or gorgonias. We have one slide with four or five opaque spots under one  $\frac{1}{4}$ -inch cover-glass, each of which has a different variety of spicules from any of the others. Each of these opaque spots is surrounded by a fine ring of asphalt. Objects are made to adhere to the opaque ground by the use of a dilute solution of gum. A drop of gum-water is allowed to dry spontaneously upon the ground, when it can be moistened sufficiently to become sticky by gently breathing upon it. Spicules or other light objects may then be sprinkled upon it, or they may be arranged in groups, and on drying they will be found securely attached.

The subject of mounting opaque objects will be continued next month, our space being already well filled for this issue, when instructions for finishing the cells will be given.

(To be continued.)

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—Messrs. Bausch & Lomb promise some novelties in their forthcoming catalogue, of some of which we have already seen the illustrations. Among other things they have designed a new microscope of the German style, which will doubtless be favorably received. It is true that this form of stand is not popular in this country, but for the investigator it possesses certain advantages of convenience and small size which will commend it to many persons.



## EDITORIAL.

**Publisher's Notices.**—All communications, remittances, exchanges, etc., should be addressed to the Editor, P. O. Box 630, Washington, D. C.

Remittances should be made by postal notes, money orders, or by money sent in registered letters. Drafts should be made payable in Washington, New York, Boston, or Philadelphia.

Subscription-price before April 1st, \$1 per year, in advance. All subscriptions after this month begin with the January number. After April 1st the subscription-price will be \$1.50.

The regular receipt of the JOURNAL will be an acknowledgment of payment.

**POSTAL CLUB BOXES.**—Box 6 came to hand last month with five excellent slides by Mr. F. F. Stanley, of Boston. They are mounts of named diatoms, which have been selected and mounted with care. It is seldom that the club is favored with preparations which have involved so much care and time in the making as these, and if a few other members would follow the example set by Mr. Stanley, membership would become more valuable than it is.

Box 29 is a special contribution from Mr. H. S. Woodman, of Brooklyn, N. Y. It contains specimens of insect preparations, and may be taken as a type of what a good box should be. Without doubt it is the most instructive box that has come to our circuit this season. There is a brief description given of each specimen, stating the general method of preparing or mounting it, followed by a few words indicating the special features to be observed. The objects in the box are:—

1. Sting of Honey-Bee mounted in glycerin. Mr. Walmsley says of this mount that it testifies to the efficiency of wax cells for fluid mounts first introduced by himself. He also refers to the value of the white-zinc cement, of which he speaks highly.

2. Head of Robber Fly, *Asilus* sp.

3. Mask of Pupa of Dragon-Fly. This is a very instructive specimen.

4. Head of Horse-Fly, *Tabanus lineola*. The method of preparing the specimen is given in detail.

5. Saws of Saw-Fly. In referring to the subject of mounting these specimens, the preparer states that in using the carbolic acid method\* he was at first not successful, but found the reason for the unsatisfactory results was that he had been using a solution of carbolic acid in alcohol. On using an aqueous solution the results were excellent.

6. Silk Worm. This is a fine preparation which shows the tracheal system beautifully.

The club has purchased a series of Cole's 'Studies,' which is now being sent through the circuits in boxes of two slides each with descriptive text. The first one that came to this circuit contained a section of *Fungus communis* and a section of diabase.

Box A, which was lost for about a month, came to hand April 8th, and a few days later came box CK. Of the latter, which contained two slides and accompanying text from Cole's 'Studies,' a section of *Euphorbia splendens* and a section of red syenite, it need only be said that it was as good and instructive as all of this series is sure to be.

Box A contains six excellent slides:

1. Pigeon post film. Dr. R. H. Ward.

2. Section of scirrhus tumor, stained with eosin and logwood. Dr. J. D. Lomax. 'G. N. K.' says it is 'interesting and well mounted,' which is very true.

3. Longitudinal section of testicle of cat. C. E. Hanaman. A fine preparation.

4. Seeds of *Saponaria calabrica*. George Timmins. These are the most beautifully ornamented seeds we have seen.

5. *Prephenus Lecontei*, said to be the larva of a water beetle. Frank Ritchie. A fine preparation, showing the trachea very well indeed.

6. Eaters and spores of *Asterella remiphærica*. Joseph McKay. This, coming from an officer of the

the club, without any description or suggestion of what elepers are, is a bad example, although a reasonably good and instructive slide.

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THE BACILLUS OF TUBERCLE.—Dr. H. Formad is one of the few conservative writers and students who have boldly questioned the conclusions of Dr. Koch and his many able followers concerning the cause of tubercular disease. While giving due praise to, and showing a sincere appreciation of, the value of Dr. Koch's discoveries, he has declared, in an article read before the Philadelphia County Medical Society, that the opinions already expressed by him have been confirmed by later experiments and observations.

The ground taken by Dr. Formad is conservative, but not obstructive or unprogressive. Looked at from our own point of view, quite outside of the medical profession, we are forced to admit that there is scarcely any experimental evidence to prove that tuberculosis is caused by the bacillus, that would withstand the severe and critical examination required to establish a scientific hypothesis. There are strong indications, reasonable inferences, but these are not sufficient.

The subject requires for its proper study not only a knowledge of the bacteria, but also of pathological conditions. It possesses an interest, however, to the whole world—and, at the present time, to the scientific world especially—in that the conclusions must yet be subjected to the severe examination of scientific truths. A subject of such vast importance demands not only careful research by the observers taking part in its investigation, but also critical examination by others of the evidence adduced. There has been scarcely enough of this. Physicians have hastily accepted conclusions which have been the outgrowth of the hypothesis put forth by irresponsible writers without the slightest reason or support, and

have actually based their practice upon them. What is now needed is a conservative spirit and a critical examination of the facts, not of the probabilities.

We would, therefore, venture to express the opinion, which is strengthened by reading Dr. Formad's article, that enough has already been done in the study of the bacillus, except as regards its life-history which still remains to be made out. It is time that the bacillus *per se* should be let alone, and that the subject of tuberculosis be taken out of the hands of mycologists, who are very good in their way, to be sure, but who seem generally incapable of going beyond the discovery and description of species of bacteria, and placed in the hands of pathologists, who, working in the light of recent discoveries, may reach conclusions of inestimable value. This is precisely what Dr. Formad seems to believe, and we can but think the influence of his work, when it is published next summer, will be felt for good throughout the medical profession.

It was our intention to give a summary of Dr. Formad's article, but it is too long to present satisfactorily in this way. It can be found in full in the *New-York Med. Journ.* of Feb. 16th.

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A METHOD OF STAINING THE BACILLUS.—The following method is given by Dr. Hartzell in the *Medical Times*:—

'A small quantity of sputum is spread as thinly and evenly as possible upon an ordinary glass slide; it is allowed to dry, which takes but a minute or two, and is then passed slowly several times through the flame of an alcohol lamp or Bunsen burner. One or two drops of the fuchsin solution, recommended by Gradle (prepared as follows: Carbolic acid, fifteen minims, distilled water, one-half fluid ounce, dissolve, and add saturated alcoholic solution of fuchsin, one-half fluid dram) are



placed upon the sputum thus prepared, and allowed to remain from three to five minutes. The slide is now washed thoroughly with distilled water, to remove the excess of fuchsin, and the stained spotum completely decolorized by means of a saturated solution of oxalic acid. It is again thoroughly washed in distilled water, after the decolorization, and allowed to dry; it is now ready to be mounted in glycerin or balsam for examination. With a power of five hundred or six hundred diameters the bacilli will appear as brilliant red rods, no staining of the back-ground being necessary.

One chief advantage claimed over other methods is that in the latter the decolorizing agent employed is dilute nitric acid; but this, besides being disagreeable to handle because of its corrosive and staining properties, is apt to remove the color from the bacilli too unless great care is taken. Oxalic acid, however, seems to leave the dye untouched in them.

—o—

#### SENSE OF COLOR OF DAPHNIA.—

Much has been written of late by various authors on the color-sense of the lower animals, but the subject is still very imperfectly investigated. Some late experiments by Mereschowski, on the color-sense of the daphnia, are of considerable interest. Sir John Lubbock has shown that these animals are sensitive to ultra-violet rays which the human eye cannot perceive. The former observer, however, finds that the daphnias are not attracted by the color of a light, but by its brightness. This question has again been taken up by Sir John Lubbock, who has reached a different conclusion after numerous experiments. He found that if a spectrum be thrown upon a porcelain trough containing daphnias, so arranged that the light on both sides of a given line was equal, the animals showed a decided preference for the green over the red end of the spectrum. Light-

ing one-half of a trough with green or yellow light, while the rest was uncolored, the animals preferred the colored light. In another trough they were found to be attracted to a part more brightly lighted than the rest. It seems proved, therefore, that they prefer green or yellow to white light. In other experiments they were found to prefer white light to blue or red.

—o—

SPRING COLLECTIONS.—The ponds are already swarming with infusoria, and fresh growths of algæ are rapidly springing forth. It is the most enjoyable season of the year for pond collecting. We have not yet been able to go out ourselves for a dip in the waters around Washington, but a few days spent in Baltimore enabled us to enjoy a few hours looking over some collections made by that enthusiastic collector Mr. A. D. Balen, who has the happy faculty of always finding something worthy of study wherever he goes. Fortunately for us, Mr. Balen, who had also been visiting Baltimore, left some bottles where we were able to examine them at leisure. Among the numerous infusoria the beautiful rotifers were abundant, and there are few organisms that are more attractive to the eye than these.

What most engaged our attention, however, was the algæ, which were abundant and of many kinds. Among them we found some fine desmids, which are often in great numbers early in the spring. Attached to some of the plants were numerous jelly-like masses, about as large as the head of a pin. These were found to be balls enclosing a bright-green branching algæ, known as *Chaetophora*. *Ulothrix* is sure to be found in almost all early spring collections. It is a slender filament with the cells about as long as broad, filled with green endochrome. Larger filaments, with cells much longer in proportion to their width, are likely to be *Mesocarpus* or *Edogonium*; the latter is readily distinguished by a series of very

close rings surrounding the ends of the cells. *Cladophora* is a bright-green alga with long cells and a branching habit. *Zygnema* is composed of straight filaments with the coloring matter arranged in stellate masses, usually two in each cell. All of these except *Cladophora* were found in the collections, and many others not so easily recognized from such brief descriptions as we have space for here. These few words will doubtless enable the collector not acquainted with the algæ to distinguish the genera mentioned when he finds representatives of them in the field of the microscope. The study of the algæ is very fascinating, and offers good opportunities for original observation.

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### NOTES.

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—Prof. Joseph Leidy has described a new annelid in the *Proc. Acad. Nat. Sci.* of Philadelphia, which he found in the Schuylkill. He has named it *Manayunkia Speciosa*. It closely resembles the marine annelid *Fabricia*, but differs in the lophophores, being undivided, in having two large tentacles continuous with the main trunks of the vascular system, and it has no eyes on the terminal body segment. It is fully described, and figured.

—Prof. Samuel Lockwood delivered an address before the New-York Microscopical Society on the evening of February 15th. His subject was 'The Wine Fly,' *Drosophila ampelophila*. After the lecture the members of the society attended a reception at the residence of Mr. F. W. Devoe, to meet Prof. Lockwood socially, where the remainder of the evening was pleasantly spent. An abstract of the address will soon be published in this journal.

—*Scandinavia* is the name of a monthly publication recently established in Chicago, which aims to present articles on ancient and modern phases of Scandinavian life, representing the chief features of Scandinavian history, mythology, literature, science, etc. It appeals to the English-reading public for well-deserved support. The articles published in the first five numbers are of a high character, and appeal to the interest of the more intelligent and thoughtful class of readers.

It is a publication of sterling worth, and we trust it will receive ample and immediate support.

The subscription price is \$2.00. Published at 24 N. Clark St., Chicago.

—So many of our readers are physicians that we would be glad to make frequent references to articles in current medical journals, but our space is too limited. We cannot refrain from calling attention to an article by Dr. A. L. Gihon entitled 'Medical Education the Fundamental Fact in Medical Ethics,' in the *Journal Am. Med. Ass'n* of Jan. 12th. It is an article that should be read by every physician; for the medical profession is responsible for the disgraceful condition of medical education in this country; and to the profession rather than to State legislation we must look for its improvement. We learn from the article that the examinations passed by surgeons in the navy are more rigorous than those of most medical colleges—so that Surgeon U. S. N. is a superior title to M. D.

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### CORRESPONDENCE.

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#### The 'Congress' Nose-piece.

TO THE EDITOR:—When I wrote the letter in regard to the so-called 'congress nose-piece,' printed on page 38 of this JOURNAL, in the February number, I had some faint hopes that Mr. Bulloch did not really intend to wrong me, but would take the opportunity thus offered to him to give me due credit for the invention, and lay the false announcement of it as his own to a 'printer's blunder.' I am sorry to note that, so far from doing this, he now claims it as his own device, admits that he had patented it before sending me the first specimen, and even boasts of his 'zeal' and 'enterprise' in giving this invention to the microscopic world—an invention, be it distinctly remembered, that I had myself made complete in all its plan and details and entrusted to Mr. Bulloch to construct for me. I have no wish to prolong a controversy with him. I shall simply say that I have drawings of the nose-piece as invented by me three and a half years ago; that I did show Mr. Bulloch sketches—not full-size, exact drawings made to scale, ready for the Patent Office Bulletin, but sketches clear and complete enough to show the exact nature of the plan and construction. I showed them to him and others at Detroit in 1880 and again at Chicago in 1883.



It was not necessary for him to 'work it out' at all, although it may have taken considerable of his time to work it out so as to try and introduce, if possible, some variation from my plan as shown him. The parties named by me do not say they never saw any details or saw any drawings. Mr. Pennock writes me that he does not recollect any, but Dr. R. J. Mohr and Mr. Ed. Bausch do recollect the fact of my showing them drawings, and of discussing the merits of the device; and Mr. Bulloch himself has shown to a certain party, since last September, the drawing I made in his own note-book, three years ago, of this very device. Whether it was the drawing I made or not I do not assert.

But I do not wish to pursue this subject any further. If you will kindly publish herewith the drawings sent you some time ago, copied from my original sketches made three years ago, the readers of this magazine will be able to judge for themselves how 'crude' the 'suggestion' was, and how much Mr. Bulloch has 'worked it out.'

It is to be noted that while Mr. Bulloch says, at the opening of his letter, that he has always given me the credit of suggesting the idea, but that he had to work it up into shape, etc., he has never publicly made any such statement in any print I have seen, but, on the contrary, has published the device as his own in this JOURNAL, in the journal of the Royal Microscopical Society and elsewhere, without a word or a hint that any one else had suggested it.

ALBERT MCCALLA.

FAIRFIELD, Iowa, March 3d, 1884.

[The figures referred to above are given on another page of this number.—ED.]

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#### Homogeneous Immersion.

TO THE EDITOR: I find in the microscopical journals nowadays a good deal about homogeneous immersion lenses, but all the articles I have seen assume that the medium used shall have the same refractive index and dispersive power as the front lens of the objective, which is usually of crown-glass of refractive index about 1.525.

It seems to me to make a lens which shall work through different thicknesses of cover-glass equally well and without adjustment, the immersion medium should correspond with the cover-glass, so that the combined thickness of glass and im-

mersion fluid would always be the same (although the thickness of each varied) for an object in contact with the under side of the cover.

The refractive index of cover glass is said to be 1.55, quite a little higher than crown glass, and its dispersive power is probably greater, as it is, or is supposed to be, a light flint glass.

By making the front lens of the same kind of glass (the Tolles  $\frac{1}{2}$ , owned by Mr. Frank Crisp, the angular aperture of which was calculated by Mr. Keith, has a front of 1.55 index), the light would pass straight from the object to the back surface of the front lens, and would allow lenses of a little greater aperture to be made.

LOUIS H. NOE.

February, 1884.

—o—

#### Cleaning Slides and Covers.

TO THE EDITOR: Regarding G. T.'s inquiry as to how slides and covers are cleaned, I would say that my practice has been to save all my failures until cleaning day, and then place them in turpentine for two or three hours or more, when they are easily cleaned with the fingers. Subsequently they are washed in liquor potassa and rinsed in soft water.

JAS. C. LATHROP.

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### MICROSCOPICAL SOCIETIES.

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A committee of the NEW-YORK Society, appointed at the meeting held December 21st, to present in a formal manner the sentiments of the society in view of the death of Mr. Robert B. Tolles, adopted the following remarks, made by Mr. William Wales at that meeting, as an appropriate and satisfactory expression of those sentiments:—

'The death of Mr. Tolles has been to me a source of deep regret. For modesty, for uprightness, for earnestness of purpose he was one of the most estimable of men. A larger capacity than his, a firmer and finer skill, a more artistic feeling, a sterner conscientiousness has seldom, if ever, been devoted to the work of making the microscope a thoroughly efficient and trustworthy aid in scientific researches. The fortunate owner of one of his fine lenses possesses one of the most exquisite pieces of mechanism ever produced by the mind and hand of man. Mr. Tolles loved his beautiful art. He loved it better than riches, for he died a poor man. He loved it better than life, for its pursuit, ne-

cessitating the constant inhalation of glass dust, shortened his days.

'The labors of such a man entitle him to the lasting esteem and gratitude of all lovers of the microscope, as well as of that field of investigation to which this instrument is the indispensable portal.'

At a regular meeting of the STATE MICROSCOPICAL SOCIETY OF ILLINOIS, held March 14th, 1884, Mr. C. S. Fellows read a very carefully-prepared paper on the Crustacea of Lake Michigan and Vicinity, illustrated by a large collection of specimens and dissections.

At a regular meeting held February 8th Dr. H. J. Detmers gave a very interesting account of a case of Glanders showing the bacillus of the same, which is quite similar to the *Bacillus tuberculosis*, but larger. He had examined the discharges from the diseased animal and found many micrococci which were formerly supposed to be the cause of glanders, but he could account for these in this case, as the stable in which the horses were kept was very dirty. The bacillus of glanders is stained by methyl violet, not by ordinary staining fluids. In the course of his remarks the Doctor referred to, and showed, the bacillus found by Prof. T. J. Burrill as the cause of a disease of the roots of the strawberry plant.

Mr. B. W. Thomas showed some slides prepared by Professor Hamilton Smith, mounted in his own medium.

A committee was appointed to examine and report upon the medium. We have not space for the full text of the report, which was signed by Messrs. B. W. Thomas, Lester Curtis, H. A. Johnson, H. W. Fuller, and H. J. Detmers, but it is stated that the 'beads' on *Amphipleura pellucida* were clearly seen, using the Abbe illuminator and various objectives. The report continues:—

'The slide mounted in a yellowish medium with a refractive index said to be 2.3 did not seem to present any marked superiority over the other. Your committee would expect these media, particularly the colorless one, to be of great value if they keep well. Their advantage in the study of diatoms is obvious. We would also expect them to be even more useful in histology if preparations can be transferred to them without injury. They may also be of great value in the study of bacteria. By the process of staining now necessary in the study of their structures, they are shrivelled and perhaps changed in other ways, and we may hope to learn

much more about them than is now known if they can be studied in these media in a more natural condition.'

## NOTICES OF BOOKS.

*The British Journal Photographic Almanac*, and Photographer's Daily Companion, for 1884. A complete compendium of Photographic Art-Science. Edited by W. B. Bolton. London: H. Greenwood, 2 York St., W. C. (Pp. 260.)

A useful compendium for the photographer, either amateur or professional, and a book that has become very popular. It is full of hints for work, new (perhaps not always improved) formulæ, and information of all kinds. One article seems worthy of special mention in this place, for it will doubtless be of value in photo-micrography. Dr. Maddox uses albumen in developing with alkaline pyro. One ounce of white of egg is beaten and mixed with two ounces of water. One drachm of the mixture is pounded into an ounce of water, and the exposed plate flowed with this. In three minutes it is poured off and development conducted as usual. A finer surface with strong half-tones is said to result from the use of albumen in this way.

*Some Algae of Minnesota Supposed to be Poisonous*. By J. C. Arthur. From Bulletin Minnesota Acad. Nat. Sci., vol. I. (Pamphlet, pp. 12.)

The algae described are *Rivularia fluitans*, Cohn, and *Celosphaerium Kurtzianum*, neither of which are poisonous, although some persons supposed they caused the death of cows and other animals using the water in which they were abundant.

*Postal Telegraphy*. Address before the Board of Trade, Scranton, Pa., November 20, 1882, by J. A. Price. Scranton, Pa.: M. R. Walter, publisher, 1882. (Pamphlet, pp. 24.)

## Exchanges.

[Exchanges are inserted in this column without charge. They will be strictly limited to mounted objects, and material for mounting.]

Will exchange various mounts of crystals for other slides, and material for mounting.

JAMES E. WHITNEY.  
Rochester, N. Y.

Wanted—Physiological and Pathological preparations in exchange for Gorgonias, Starches, Microfungi, Vegetable Hairs, &c.

W. R. MANDEVILLE, M. D.,  
154 Canal St., New Orleans, La.



# THE AMERICAN MONTHLY MICROSCOPICAL JOURNAL

VOL. V.

WASHINGTON, D. C., MAY, 1884.

No. 5.

## A Focussing Glass for Photo-Micrography.

Doubtless most of those who have attempted photo-micrography have experienced the same difficulty at the outset as myself. I found that no matter how finely my focussing glass screen was ground, it would not allow the finer details of objects to be seen. I had no focussing glass, my half dozen eye-pieces were all positive, and in the absence of a Ramsden, or negative, eye-piece, I determined to make one of these do. I took a narrow strip of thin board  $15 \times 2 \times \frac{3}{8}$  inches, and in its centre cut a circular hole through which I could just force one of my eye-pieces with considerable pressure and a screwing motion (fig. 17). Now throwing back my ground-glass screen and allowing the projecting ends of the strip to rest upon the edges of the camera box, I had as clear and distinct an image as in looking through a microscope.

To adjust my glass to the position occupied by the plate during expo-

sure, and clearest focus was obtained, making a mark upon the eye-piece to serve in case of accident, and the glass was finished. Whenever I focus with it I know that the image will fall exactly upon the front surface of my exposed plate. For microscopical work I never think of using any other means of focussing, as it gives a clear, brilliant image, magnified and exhibiting every minute detail, does entirely away with the necessity of the black cloth, and does not necessitate the use of a plain glass screen as does the ordinary focussing glass. My first attempt with my glass was upon *P. angulatum*; which I proposed to photograph by lamp-light with a  $\frac{1}{4}$  Tolles homogeneous immersion objective and a 2-inch ocular, the plate being exposed less than 50 cm. from the object, and giving an image only 37 mm. long. Upon the screen no appearance whatever of the markings was visible, but with my glass I was able to focus so that my negative showed the clear hemispherical bosses.

GEO. O. MITCHELL.



FIG. 17.—Photographic Focussing Glass.

sure, I focussed with the regular screen upon a printed text placed at some distance from the camera, using my ordinary view lens, being careful to get the edges of the letters as sharp as possible. Then throwing back the screen, being careful not to change the position of the bellows, I applied my eye-piece with its carrier resting against the edges of the box, and screwed it in or out till the sharpest

[The plan above described is a most excellent one, not only because it enables the focussing to be done very accurately, but because it also enables certain corrections to be made with ease. It will readily be seen that when an objective is used which is not well adapted to photographic work, owing to the difference between the focus for vision and that for actinic rays, the eye-piece can be so adjusted, by experiment, that when the image is sharp as seen in the eye-piece the actinic rays will be focussed on the plate.—ED.]

## Preparation of the Ethyl Ether of Gallic Acid.

R. DORSEY COALE, PH. D.

At the request of Prof. Christopher Johnston, I send a description of the method of preparation of the ethyl ether of gallic acid. Of course this method of preparation is not original with me, and my only object in sending this description is to enable the readers of the JOURNAL to prepare for themselves, or to have prepared for them, this substance which, in the skilful hands of Prof. Johnston, has proved to be such a beautiful object for the polariscope; for, although it can scarcely be considered a rare substance, it is not one which would be likely to be found in the stock of most dealers in chemicals.

The ethyl ether of gallic acid, or ethyl gallate, can readily be prepared by passing dry gaseous hydrochloric acid (generated by the action of sulphuric acid upon ordinary salt) through an alcoholic solution of gallic acid.

When the solution is saturated with hydrochloric acid it is evaporated to dryness on a water bath, the residue redissolved in hot water, the excess of acid neutralized by the addition of finely powdered chalk, and the mixture filtered. The clear filtrate left to itself yields, on cooling, long needles which are usually colored dark brown, but can readily be purified by one or two recrystallizations from water.

When pure, ethyl gallate crystallizes in small oblique prismatic needles which are yellow, brilliant, and transparent when wet, and opaque white or slightly yellow when dry; it is but little soluble in cold water, but is readily soluble in hot water, alcohol, and ether.

The process of preparation is very simple, but, like most of such processes, requires some care and neatness to obtain the best results; and upon the purity of the substance its beauty as a microscopic preparation seems in great measure to depend.

UNIVERSITY OF MARYLAND.

## An Eye-shade for Monocular Microscopes.

BY R. H. WARD, M. D., F. R. M. S.

In using a monocular microscope much of the fatigue, both to eye and brain, is avoided by habitually employing a shade in front of the unused eye. A maximum of comfort seems to be attained, not by a large shield that completely darkens one eye, which itself becomes tiresome by reason of the great contrast with the intensely illuminated eye over the microscope, but by a stop of moderate size and at some distance from the eye, which, while preventing the confusing effect of an image in the unused eye and the fatiguing effort required to keep the observer's attention confined exclusively to the microscopical image in the other, still allows the entrance of much diffuse light, and permits, without abrupt transfer from darkness to light, the frequent changes required from rest over the shade to inspection of books or memoranda or of other objects upon the table.

Having recently had occasion to employ a monocular instrument for certain purposes, after having used the binocular exclusively for more than fifteen years, the writer has been led to recall an almost forgotten form of shade which he contrived and used with great comfort some twenty-five years ago. Doubtless individuals have often made just as good and simple shades for their own use; but the writer has never happened to notice one, either made or described, and he therefore brings this forward in the hope that it may thereby become as useful to some others as it has been to himself. His experience leads him to believe that some such contrivance should always remain fixed upon a monocular microscope while it stands upon the table ready for use, even occasional glances into the tube being more tiresome without this accessory than with it.

It consists, as shown in fig. 18, of a circular disk of hard rubber or black-



ened metal, about  $1\frac{1}{2}$  inches in diameter, an extension of which in the form



FIG. 18.—Dr. Ward's Eye-shade.

of a band half an inch wide crosses in front of the nose of the observer, but quite out of the way, and encircles the top of the draw tube or compound body just below the ocular. As now used, this shade is made of hard rubber, which is of light weight and suitably dark color, is less adapted than metal to scratch the brass-work with which it comes in contact, and is so elastic as to be applicable to a considerable variety of tubes. The same shade, for instance, can be used on tubes of from 1 to  $1\frac{1}{4}$  in., or from  $1\frac{1}{8}$  to  $1\frac{3}{8}$ , the best fit being of a size midway between the two extremes. Besides this range of easy adaptation to various instruments, this eye-shade differs from the best hitherto in use in its attachment to the body instead of the ocular, by which it is brought to an advantageous distance from the face, and is retained in position as long as the instrument is in use, instead of being removed with the ocular and requiring a fresh application every time that that is changed. It is reversible by simply turning it over, and can thus be instantly transferred from the left to the right eye, according to the observer's custom of using either eye habitually or both in succession. It is equally applicable to stands whose construction does not admit of its being slipped over the tube from the top, the spring ring at the right of the figure being in such cases made partly open so as to spring on from the side. It is now made, of any required size, by the Bausch and Lomb Optical Co., of Rochester, N. Y., and is cheap as well as useful.

TROY, N. Y.

## Blue Staining.

In the June number of the JOURNAL for 1883, I gave some account of remarkable effects produced by a blue stain made of rosanilin, anilin oil, and sulphuric acid. Since the publication of that article I have used the stain constantly. For a double stain with carmine I do not think it has an equal.

The object of this brief article, however, is to call attention to the fact that it gives surprisingly fine results with micrococci, bacteria, bacilli, etc. Whether the mount is in balsam or glycerin, the result is excellent, though the glycerin mounts are, in some respects, preferable. I have some of the *Bacillus tuberculosis* stained with the blue and mounted in glycerin, which stand out full and round, the best and most natural showing of them I have yet seen.

By rapidly staining with the blue and drying the slide, then mounting in balsam, I have succeeded in getting the bacilli white on a blue ground. Some of the best results have been secured with *B. termo*, *vibrio* and *spirillum* forms, especially when mounted in fluid. In some cases the spores have swarmed from the zooglea mosses, and arranged themselves on the cover-glass like myriads of blue dots.

Following a suggestion in the report of methods of work at the zoological station, Naples, I immersed a number of slides in a pond or bog-hole, and let the fungi, algæ, desmids, infusoria, etc., attach themselves to them, and then I let a few drops of the blue stain flow over them and mounted in fluid. The result has been all that the most enthusiastic student could ask.

It may be of interest to the readers of the JOURNAL to know of my method of suspending the slides in the water. I first got a small wooden hoop, then suspended from it a number of the American clip clothes-pins.

Placing two slides back to back, so that the growth should be on one side only of a slide, I put them in the pins in couples, and then strapping over the hoops a piece of wood sufficient to flood the whole, I put it in the water, and left it long enough for my purpose. As a result, I have a number of slides in various stages of growth, of schizomycetes, desmids, algæ, infusoria, etc., which I would not part with for a great deal, surely not at all if I could not duplicate them.

F. T. HAZLEWOOD.

### The Improved 'Investigator' Stand.

The Bausch & Lomb Optical Co. have greatly improved their 'investigator' stand, and we give this month an illustration of the instrument in its present form. It will be seen that changes have been made in the

mode of attaching mirror and sub-stage, which now swing independently of each other on separate arms, graduated to show the extent of angular movement. The position of the body-rack has been changed, giving a greater range of motion, and the stand as a whole is improved in appearance, and seems eminently adapted to the wants of a large class of general microscopists. Further particulars concerning this stand are given in the supplementary catalogue recently issued by the firm.

We would call particular attention to the artistic excellence of the woodcuts used by this company in their catalogues. Some of them are very superior, and the one here given is admirable.

### Mounting in Balsam in Cells.

BY R. P. H. DURKEE.

The same or a similar method of balsam mounting in cells may have already been worked out by others, but on the assurance of several of much greater experience than myself, that they had never seen anything of the kind, and on their approval of what, so far as I know, is entirely original, I send you a specimen and a short description of its preparation for publication in the JOURNAL. Its preparation differs from others in that there is no previous building and drying of the cell.

A curtain-ring, flattened by pressure, is placed upon a clean slide and the slide placed on the hot table. Drop in the centre a small portion of balsam, enough to fill the cell, and heat till the air-bubbles rise and permit of breaking with the needle, at the same time gently moving the ring about, and pressing it down to

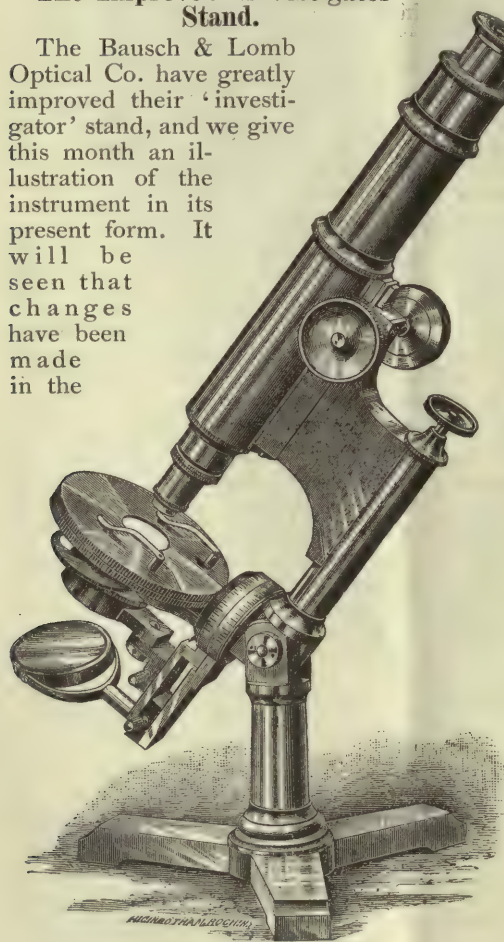


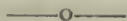
FIG. 19.—Bausch & Lomb's 'Investigator,' improved.



insure contact with the slide. Place the object in the balsam, taking care to see that it is completely covered; warm the cover and place it in position, in doing so holding it in the forceps parallel with the surface of the slide, so as to expel the air all around; weight down with a Minnie bullet, and apply heat as may be necessary to harden the balsam.

The result of this manipulation you see in the slide sent you by this mail, it having been mounted, cleaned, labeled, and ringed, in other words finished inside of three hours. What I consider quite a feature is this, that there would seem to be no possibility of varnish running in, the channel in the top of the ring receiving the excess of balsam when pressed out by the cover, and thus forming a barrier to the influx of the varnish used in ringing. For flattening the rings I use two plates of brass,  $2\frac{1}{2}$  inches square by  $\frac{1}{8}$ -inch thick. Place the rings, six or more at a time, between the plates; press in an old notary lever stamp. This method of mounting seems to have the following desirable features, viz: no previous preparation and drying of cells, rapidity and neatness of finish, and no running in of varnish.

[The mount which accompanies the above communication is certainly a very neat one. We confess to a little surprise that the balsam does not run out beneath the loose ring, for we have a dim recollection of having tried the method once, but our rings were not flattened.—ED.]



### Structure of the Diatom-shell.— III.

BY JACOB D. COX, LL. D., F. R. M. S.,  
PRES. AM. SOC. OF MICR.

The diatoms of which we have examined the forms have thus far been of the bolder marked kinds, in regard to which the existence of areolæ in the valves is so plainly shown by the lines of fracture that there has been little or no dispute about it for some

years. The difficulty begins when we leave these and take up some of the species and varieties which have much finer marking.

The most satisfactory method of examination will be found in a progressive study of specimens from each of the more important groups and families, beginning with those having the larger features and passing on to the more delicate. We shall first notice that in the great variation in size which occurs in all species of diatoms we have presented to us examples with a considerable range of diminishing areolæ also. In different individuals of the same size there is also often found much difference in fineness of areolation. The gigantic forms of *Coscinodiscus oculus iridis* found in the Maryland deposits become as small as *C. radiatus*, and the latter is often found in recent marine gatherings side by side with *C. subtilis* and of no greater size.

We are able, therefore, to follow the diminution of undoubted hexagonal areolæ from the greatest of these specimens, where the valves measure .016 inch in diameter, till they are scarcely one-eighth as large. Then taking up *C. subtilis* with its hexagons in the larger valves as clearly marked in outline, we find another diminishing series, in which the sharpest scrutiny still leaves us in doubt when we pass from the hexagonal form to that of round punctæ. In this progression we find that the areolæ continue to be the weak places in the shell, the fracture following them in the smaller as in the larger examples. Examined by aid of the vertical illuminator, the surfaces of the valve continue to show the characteristic reticulation and 'eye-spots' as long as we can trace distinct form at all. As the hexagons become smaller, we see by transmitted light that they show more color when the tube is lowered a little and they are thus brought a little within the focus. In the smallest of these in which we can clearly define the hexagonal out-

line the spot becomes quite deeply red. If we next select a valve in which the dots are a little more distant from each other and evidently round (the scheme of marking and the marginal spines being the same as in the larger specimens), we shall find the same conduct with regard to color when the objective is lowered or raised; that the fracture indubitably follows the line of the dots, and that under the vertical illuminator the smaller dry specimen is not distinguishable from the larger except in the roundness of the areolæ.

Pass now from *C. subtilis*, as we find it along our own coast in gatherings shown in Peticolas's slides from Jacksonville or Fernandina, Fla., to the *Odontodiscus subtilis* of Möller's type plate or his slides of gatherings from Wedel marshes or those of Holland. We have Prof. H. L. Smith's authority for regarding this diatom as identical with *C. subtilis*, and it is, at farthest remove, only a variety of that species. No distinctly hexagonal areolation is seen here, but the punctæ are round, though often so closely set as to lead the eye very persuasively to the illusion of taking them for hexagons. Remembering Nacet's figure demonstrating the liability to mistake on this point, and using to the full the advantage our widest angled glasses have in seizing upon the surface, we shall soon satisfy ourselves that we have round areolæ in a shell of silex showing a pinkish tint. The light within the areola, when the outline is in sharp definition, is of the general pale greenish color of the field. Depress the tube, and the dots become red spherules; decenter the light from the condenser a little, and they stand out like little balls. Among these valves I have found very numerous examples in which the fracture evidently follows the line of the areolæ. In one specimen a segment had been broken out, one side of it bounded by a regular radial line from the centre of the shell to the circumference. In it the next row of areolæ

was plainly separated from the broken part by a line of silex of appreciable width, on the outer edge of which the little irregularities and indentations of the fracture showed where the divisions between the adjacent dots had been. In both the American and the European diatoms I have also occasionally found the two laminae of the shells of this species separated partly or wholly, as has been noted in the larger species of *Coscinodiscus*, and in such cases the fracture of the inner lamina through the 'eye-spot' is even more demonstrably apparent than in the perfect shell.

The evidence from fracture of the valve and from the general appearance under the vertical illuminator, therefore, justifies the conclusion that the truest view of this diatom by transmitted light is that which we have when the objective is so adjusted that the punctæ appear to be sharply-drawn circles in a film of pale pink color, the circles themselves having a greenish white light. We may consequently reject the red spherules, in this case, as the product of diffraction and interference of light. Another bit of experimental evidence on the subject is found in the way in which, on a slight motion of the mirror, the light will flash along behind a diatom, lighting up the areolæ as it passes, and making the comparative darkness of the thicker part of the shell apparent in a telling way. Dr. Greville refers to this in his description of *Aulacodiscus orientalis* (*Q. M. J.*, vol. IV, N. S. 12, Trans.), as making it very evident that the areolæ in the clathrate framework of that beautiful diatom are really thin, window-like spaces, through which the light flashes. The effect is not easily described in words, but it will be recognized by all who have had much experience in studying diatoms under the microscope.

Another species of diatoms will aid us to carry our induction a little further. In either of the gatherings I have mentioned we may readily find



specimens of *Podosira Maculata* (*Hyalodiscus Stelliger*, Bailey), and these will be found of very varying degrees of fineness in the marking. In the European slides I have generally found them coarser than in gatherings from warmer seas, but they differ a good deal in the same place. The shell is made up of segments radiating from the large granulated umbilicus, and these segments are marked as if cut from sheets of perforated silex and bent into place on the convex surface of the valve, the edges of the segments often showing lines of apiculi obscuring the suture. In the coarser specimens the areolæ are but little more difficult to define than in *Odont. Subtilis*, and in broken ones the fracture may be unmistakably traced through the punctæ. The color test shows also the same appearances as in the species last described. From this we may follow the increasing fineness of the marking till the dots run together into a diagonal striation rivalling the *Pleurorismas*, and approaching (though with a considerable interval) that of *Hyalodiscus Subtilis*.

As far as we can succeed in defining small areas and minute irregularities of fractured edges, we find the hexagons diminishing to dots and these to still finer punctæ, but they continue to have all the characteristics of an arrangement of areolæ between two laminæ. It is fair to conclude that in those specimens of *Podosira maculata* in which we cannot define the areolæ, they nevertheless exist; and we might add that it is at least probable that the same structure would be found in *Hyalodiscus Subtilis* if our glasses were more powerful. I intend to continue for the moment, however, within the region of observation, and to postpone drawing conclusions till we have examined a greater number of species.

The *Actinocyclus*, in its different varieties, is a very interesting genus to study in connection with the preceding series. It is found with discs of less than .001 inch in diameter, and

running up to the splendid proportions of *A. Ralfsii*, measuring sometimes over .008 inch. In some of the smaller species the dots are comparatively large, and the disc will be found subdivided by six or more radial lines of areolæ, each line containing only six or eight of the large dots. In the larger kinds the rays are often fifty or more, with as many areolæ to the radial line. The segments are filled, of course, with similar areolæ, arranged upon a series of parallel lines. I think I may say that of all the species and varieties of this disc which I have examined, there is none of which I have not found examples of separated laminæ, showing inner and outer plates as in *Coscinodiscus*, and none in which the line of fracture does not prove the dots in both plates to be the weak places. Some of the smaller discs with large areolæ are found in gatherings from the Samoa Islands and other places in the Indian Ocean. Möller's slides from the Baltic at Kiel give a large range of sizes and conditions. A preparation of *A. fuscus* (*Cos. fuscus*, Norman) from Yarra Yarra, Australia, made by Wheeler, shows an unusual number of separated laminæ, an examination of which will confirm my assertion. The fossil earths of Nottingham and Calvert Co., Maryland, are full of *Actinocyclus*, and the deposits of Santa Monica and San Luis Obispo, on the Pacific coast, are rich in various forms of the same genus, with great range in the size of the punctæ.

There is a tendency in most of the species to accumulate silex upon the spaces between the areolæ, giving a roughened and irregularly granulated appearance to the outer surface of the disc. This condition also interferes with a satisfactory examination of the 'dots' by causing irregular refraction, &c. For this reason we need to select smooth and evenly-marked specimens for one part of the investigation, though for another the roughened examples are most instructive. We find this thickened coating broken away

in different degrees; sometimes leaving the shell smooth but perfect; sometimes taking with it the outer lamina and leaving only the inner with its delicate punctation. The fact that the thickening is upon the interspaces between dots is additional evidence that the latter are areolæ, since they allow the light to pass when the thickened walls around them make a semi-opaque outline approximating the character of the shell in *Eupodiscus argus*. But among these roughened specimens I have more frequently found the separate inner lamina, and this, when once caught by the glass, is always the most convincing proof of the scheme of marking of the valve; for the film is so homogeneous and even, and the dots upon it are diminished to so fine and regular punctæ that the eye is never dazzled; confused, or misled in following its delicate pattern.

The examination of the several species last referred to, under the vertical illuminator with high powers, and as opaque objects with the quarter-inch objective, is strongly confirmatory of the interpretation I have given. Reflected light may be made to flash from the surface of all the finer examples of *Cos. subtilis* as well as from *Actinocyclus* and *Podosira*, so as to show a glassy smoothness, with a play of iridescence in the thinnest specimens. This is true of both the convex and concave surfaces of the valves. No trace of projecting spherules can be seen in such an examination, though the dots of the shells are of such appreciable magnitude that they would easily be visible as protuberances if they were solid spherules. Indeed, with the vertical illuminator and a high power, silicious fragments or broken sand-grains may often be seen lying upon the surface of these shells, very much smaller than the areolæ, and demonstrating by the ease with which they are seen, that if the dots approached hemispheres in form they also would be perfectly apparent. This, then, is another strong proof

that these areolæ are contained between smooth and parallel laminae.

If finally, still using the vertical illuminator and a high power, we review the series of valves beginning with the boldest forms of *Triceratium* and *Coscinodiscus*, and ending with the finest *Actinocyclus* and *Podosira*, we find certain appearances consistent throughout the whole range of examination. The areolæ, when the surface is carefully brought into focus and the cover correction accurately adjusted, is always an opaque white or grey, whilst the surrounding walls or solid part are darker, becoming even black when close to a dark background. The comparison which I have already made to ice upon a pond, when part of it is solid and clear and part of it porous, very aptly describes this appearance. There is no break in the series. From coarsest to finest the only change is that the areolæ grow smaller in fact, and generally smaller also in comparison with the solid parts of the shell; but the light is reflected from the surface in the same way, and the experiment ends with a conviction that the differing methods of examination all lead to the same conclusion.

In examining diatoms as opaque objects with the middle and low powers, the appearances vary more than they do with the vertical illuminator, because, as the light is necessarily oblique, its variations of direction produce changes of appearance. Parts which look dead-white with the vertical light may appear dark, and the thicker portions of a shell also change color; but the changes of manipulation of the mirror give so many variable experiments as to end in strong confirmation of the results reached by the other means. In opaque mounts the thinness of the shell is shown better than in any other form of preparation. From the dense *Eupodiscus argus* we find every degree of diminishing thickness till we come to an *Actinocyclus* lying upon the black slide, its flat disc as



black as the background itself, except when the tiny white spots of the areolæ pick out the pattern of its marking, or the projecting rim of the valve marks its circumference. So a *Podosira* or *Cyclotella* will be seen, the merest soap-bubble with its play of colors and its manifest tenuity, speaking plainly of the extreme delicacy of the film of silic.

We will pass over the irregular disc forms for the present, and next consider some of the Naviculæ.

(To be continued.)

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### Dr. Koch's Pavilion at Berlin.

[The following article is copied from the *Journ. Am. Med. Ass'n*, and is a translation from the *Revue Medicale de Louvain*. It is of especial interest at this time, when so many persons are working in the same field as Dr. Koch, whose name will always be identified with this department of research.—Ed.]

'In 1876 the Imperial German Government established a central committee to supervise the sanitary condition of the Empire, and to contribute directly, by especial researches, to the progress of hygiene. This committee, called the Reichsgesundheitsamt, was composed of five persons, who were to collect, arrange, and exhibit all material pertaining to the study and practice of hygiene, and to give its aid to the Minister of the Interior in the study of questions relating to hygiene, and in the preparation of laws and administrative measures relative to the same subject. In 1878 the committee was enlarged, and the Government appropriated generously the funds necessary for thoroughly equipped laboratories for original researches intended to solve certain important hygienic problems.

'The building itself is located in the centre of the medical quarter of Berlin. It consists of a very large house with a cellar, ground floor, and

two stories, with laboratories for chemistry, hygiene, and experimental pathology, numerous work-rooms, a statistical bureau, library, lecture-room, consultation room, dwelling-rooms for the Director, and chambers for the assistants, with, finally, motor apparatus, rooms for disinfection, for combustion, for incubation, dark chambers, photographer's room, etc.

'The *personnel* is made up of a Director, Dr. Struck, and four ordinary members, viz: Dr. Koch, Prof. Roloff, of the Royal Prussian School of Veterinary Medicine; Profs. Sell and Wolfftingel, of the University of Berlin; of nine assistant physicians, and a sufficient number of employes to perfect the service. Besides these there are 25 extraordinary members chosen from among the most eminent hygienists in the principal cities of Germany. The Reichsgesundheitsamt erected a pavilion in the park of the Exposition of Hygiene, which contained two laboratories. 1. A laboratory for the analysis of alimentary substances. 2. A laboratory for researches into infectious diseases and the modes of disinfection. \* \* \* \* \*

'Dr. Koch commenced his work on the microbia when he was a country physician, a *Kreisphysicus*, in a very small village of Silesia. It was in the midst of his duties as a practising physician that he commenced and carried on those admirable labors which mark an epoch in our knowledge of the infinitely minute world. Gifted with sagacity and an exceptional clear-sightedness, joined with dexterity and the spirit of order and method, and with an indomitable perseverance, he made his first essays like those of a master. With a sober manner and a style that is clear and curt, the most of his works are spread over but few pages, but every question submitted to his researches comes back perfectly answered from his hands.

'To affirm that a given disease is the product of a special germ, Dr.

Koch exacts the three following conditions:—

‘1st. The germ should be found in the diseased organism, in its secretions or excretions. It must be found in such forms and groups as show its special and characteristic dispositions.

‘2d. The germ must be capable of cultivation out of the body, and isolated from all living material and other germs.

‘3d. The germ so cultivated must be capable of being reproduced in the living organism of the original disease.

‘If these three conditions are satisfactory, the proof is complete.

‘1st. To ascertain the presence of the germ, Dr. Koch uses the simple and direct means, but more generally calls to his aid the anilin staining fluids, which possess a special affinity for the germs or microbia; and in the pavilion are to be seen the Abbe condenser, the different models of microscopes used in laboratories, and all made by Zeiss, of Jena.

‘2d. The microbia are sown in a suitable medium and kept at a proper temperature, where they multiply with a differing degree of rapidity, according to their species. As the use of a liquid medium presents certain objections, which render it difficult, laborious, long, and uncertain, Dr. Koch, in searching for a more solid medium, has utilized the potato, which he sterilizes by first soaking it in a solution of corrosive sublimate for an hour, and then places it on a sieve in an iron box holding water to the depth of several centimeters, over which this is placed. The box is closed by a cork pierced by a thermometer; the temperature is raised to 212°, and kept so for from one-half to one hour. The potato is cut with a heated knife-blade quickly, and in as pure air as possible, a drop of the liquid to be examined placed upon it, and the whole covered by an hermetically sealed bell glass. Each species develops its own peculiar form of culture islet, which can be recognized by the naked eye. Thus,

one sees a group of the *Micrococcus prodigiosus*, the bacteria which gives the green color to pus, the *Bacillus anthracis*, or—and here bread is preferred as the medium of culture—the *Oidium lactis*, the *Aspergillus glaucus*, etc.

‘By the aid of gelatine Koch is enabled to study cultivation in alimentary substances, such as the bouillon of different meats, saline solutions, Pasteur’s liquid, etc. It has the advantage of jellifying at the temperature suitable for the cultivation of these germs, but the disadvantage for others, as for milk, of liquifying at a higher temperature. In this way he obtains the germs of chicken cholera, of typhoid fever, erysipelas, anthrax, septicæmias, the *Bacterium termo*, etc. In the study of the germs which produce lactic fermentation, butyric fermentation, blue milk, etc., these germs have been so far isolated and cultivated that it would seem as if before long the mystery attendant upon the numerous alterations of milk would be unveiled in its minutest details. As has just been said, gelatine not proving suitable, Dr. Koch takes the blood serum, pure, or gelatinized to facilitate its coagulation. He selects, by preference, the blood of an animal subjected to the disease of which he desires to study the germ. It (the blood) is taken from the carotid and collected carefully in a vessel, where it is allowed to remain until the contraction of the clot expresses the serum, which serum is then taken up by pipettes previously heated, and distributed into a series of test tubes that have also been sterilized by a prolonged heat of 302° to 320°. The serum in these test tubes is then sterilized by being placed in a suitable vessel, and submitted daily to an hour’s temperature of 136.4° F. for about six days. This results in a feeble coagulation of the serum, which remains transparent and quasi-gelatinous. To prevent the water of the serum from resting on the top, the tubes are laid obliquely. To carry on these investigations properly, a delicate



regulation of temperature is necessary, and for this purpose the thermostat of Arsonval is used, which allows of a constant heat to  $\frac{1}{10}$  of a degree centigrade. The culture of the bacillus of tuberculosis has been so made, and in the same way the bacillus of glanders, of osteomyelitis, the microbia of the septicæmia of the rabbit, of the turkey, etc., etc.

Much laboratory work has been done in the bacteriscopic examination of the air, the water, and the soil. To examine the air of an apartment, it is simply necessary to expose sterilized slices of potato upon which the germs fall and colonize themselves. For water, a weak solution of gelatine, with the necessary nutrient salts, is mixed with a small proportion of the water, left to the surrounding temperature, and in a little time the solidified gelatine shows whitish or grayish granules, which the microscope resolves into colonies of special germs. To estimate the proportional quantity of these germs, the contaminated gelatine is spread out on a large plate of glass over paper that has been ruled and counter-ruled so that a rapid and satisfactory count of the islets of microbial vegetation can be made. Thus are to be seen the fractions of a drop of the water from the canals of Berlin, of pump water of the public fountains, of sewer water, and of the water of the river Sprée, above and below Berlin, these last demonstrating in a striking manner how water becomes contaminated, and how it purifies itself by nature's processes. Nothing is more curious than to examine these plates covered with little clods of turf, islets of dust, white, green, and brown spots, little collections of pearls, and a crowd of special forms, so diverse as to appear like a public park or garden in miniature. As in all the other analyses, each variety of vegetation, after being carefully examined by the microscope to ascertain its purity from all foreign mixture, receives an isolated culture with the most diverse sub-

stances, in turn submitted to its influence.

3d. Finally comes the reproduction of the original disease by the aid of the artificially developed germs. This has definitely proven for the microbia of charbon by Pasteur, of tubercle by Koch, and for the bacteria of glanders, the coccus of erysipelas, etc. The pavilion displays numerous anatomical specimens from rabbits, dogs, and other animals that have been inoculated with the bacteria of tuberculosis, cultivated to the tenth, twentieth, and higher generations, and which demonstrate positively the presence of tubercles in the different organs. Other specimens show the inoculation of the cultivated bacteria of glanders on the rabbit and on the horse. The nasal mucous membrane and the ulcerated ears so exhibited give the most positive evidence of this infection. A group of photographs on glass completes the series of objects exhibited. These direct reproductions of the different varieties of the known pathogenetic inferior organisms, as well as the disposition they affect in the diseased organs, are for the most part, in spite of the often enormous enlargement which they have undergone, of an absolute sharpness and admirable precision of detail.'

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### Microscopical Technic.

#### IV. MOUNTING OBJECTS DRY, CONTINUED.

We have now to describe the method of mounting objects that require deep cells. Such objects being opaque may always be mounted in cells with opaque bottoms. The bottoms of the cells may be made with either of the materials mentioned on page 74, or dead-black paper may be used cut to fit the cell and held in place by mucilage. The cells may be formed in various ways, but the method that has proved most convenient and satisfactory in our hands is one that has been roundly criticised

by many others. We refer to the process of mounting in cells made of wax. Many writers have condemned the method, on the ground that in time a peculiar deposit forms on the lower side of the cover-glass in all wax cells. Such a deposit has not been observed by the writer, and as statistics may be regarded as of value in this connection it may be said that in the year 1877 we prepared a large number of slides of foraminifera in wax cells. Opening a drawer in the cabinet this morning we found twenty-five of those cells, and the covers of all are as clear as when they were put up. With such experience we do not hesitate to recommend the use of wax cells, but owing to the numerous complaints from others we would advise those who do use them to follow strictly the methods that have proved successful in our hands.\*

*Mounting in Wax Cells.*—Unfortunately black wax cannot be obtained, but the darkest olive-green wax in sheets, as sold for making wax flowers, is a good substitute, and has been exclusively used by us. The entire cell may be made of wax, but we generally prefer to use curtain-rings for the sides and wax for the bottom. In making the entire cell of wax the method is to put a sufficient number of sheets together to make the required thickness, cut out a square, or punch out a round piece of proper size, place it on a slide on the turn-table, pressing it down to make it adhere, and then turn out the cell with a pen-knife. The details of this method have been given in back numbers of this JOURNAL.†

To make the cells with curtain-rings proceed as follows: Select the ring to be used, a  $\frac{1}{2}$ -inch or  $\frac{3}{8}$ , ac-

cording to the object, and punch out a single thickness of wax as large or a trifle larger than the outside diameter of the ring, for which purpose a gun-wad punch will be found very useful. Place the wax upon a slide, centre it on the turn-table, lay the curtain-ring upon it and centre that. Then hold the slide over a lamp until the wax softens, but do not let it melt or the finish of the surface will be spoiled. The ring thus becomes embedded in the wax, and if it should be slightly decentered by the operation the slide may be returned to the turn-table while still warm and the error corrected.

As soon as the wax cools the ring will be found firmly attached to the slide, the bottom of the cell will be clean and smooth, quite ready to receive any object.

The object may now be placed in the cell and caused to adhere by means of gum water or by softening the surface of the wax with spirits of turpentine on a brush. When the turpentine evaporates the objects will be found securely attached, and the cover-glass may be applied.

To cement the cover-glass we are accustomed to use clear shellac in alcohol, as described last month. The cover being securely cemented down the next operation is to finish the outside of the cells, so as to give them a neat appearance. This may be done in white, black, or in various colors, but as a rule the neatest mounts are the plainest.

A white finish may be given with white zinc cement, which is a good material for finishing slides, but not reliable as a cement for making cells and holding covers, as it is liable to run in after a time. Perhaps it is possible, by extreme care in drying the cement, to avoid running in, since it is true many good mounters use it, but we are writing from a tolerably extended experience, and the presumption is that this experience is a reasonably good indication of what others will have, who are no better or

\*Dr. E. Weissflog is of the opinion that the spoiling of preparations is partly due to the cover-glass itself, which has been observed to become covered with moisture[?] on the surface when packed away, or perhaps decomposed on the surface. See vol. ii, p. 49.

† Vol. i, pp. 46 and 150.



worse in manipulation than ourselves. Our assertions concerning this cement\* have been flatly contradicted, but, as it seems, without sufficient regard to experience and facts. The reader will do well to fix his faith upon shellac, and use the white zinc outside only.

A black finish is best given with asphalt. We prefer to round out the cells with the asphalt and gold-size mixture, letting one or two coats run up over the edge of the cover-glass, and then finish with asphalt alone. The reason for this is that the mixed cement is more elastic than the asphalt alone, and will hold the cover more securely.

A method of finishing that is to be highly recommended has been long used by Mr. C. F. Cox, and his mounts present a very attractive appearance. He uses what is known in color shops as Munich lake, which is sold in collapsible tubes.

*Mounting in Cement or Ring Cells.*—Deep cells may be made either by cementing curtain-rings to the slide by means of shellac, marine glue, or other mixture, or by building up cells with some cement or ground pigment in oil. When using the curtain-rings they may be flattened by pressure, as described by Mr. Durkee in another column, or even with a hammer, in case they should be too deep, and this has the advantage of giving them a greater surface to adhere by. The reader will find numerous methods of making opaque cells by looking over back volumes of this JOURNAL.

To build up cells of cement or ground pigment the best method is to take up a considerable quantity on a small brush and spread it on the middle of the slide on the turn-table. Then with the pen-knife turn up the cement in a ridge to form the cell of the proper size and depth. For such cells we advise the use of thick, plain shellac, but if it is desired to make a

more ornamental ring the shellac may be thickened with vermilion. The greatest care should be taken that such cells are thoroughly hard before they are used.

To mount in such cells the bottoms should be covered with black paper, or by one of the dead-black mixtures mentioned on page 74. The cover should be cemented on with shellac, and the finishing done precisely as described for the wax cells.

We have already mentioned the use of gum water to attach objects to the slides or to the backgrounds of cells. A superior liquid for this purpose was mentioned in one of the preceding volumes of the JOURNAL, but we give a more full account of its preparation in this place. It is a solution of arabin or purified gum arabic, the use of which was suggested some time ago by Mr. H. J. Waddington, who describes the method of preparing and using it\* as follows:—

‘To obtain arabin for microscopical use, gum Arabic should be selected as clear and white as possible. This is to be dissolved in distilled water to the consistence of thin mucilage. It should then be filtered, and the filtrate poured into rectified alcohol and well shaken. The arabin immediately separates as a white pasty mass, and the whole becomes semi-solid. It must be placed on filter-paper, and washed with alcohol until the washings are perfectly free from water, and the alcohol comes off as pure as it went on. The arabin may now be allowed to dry spontaneously. The edges of the surface of the mass will probably be found to be viscid, owing to the absorption of water from the atmosphere or from the alcohol—but the remainder will be a perfectly pure white powder. This should be shaken off the filter and preserved.

‘Like ordinary mucilage, it is very liable to become mouldy if kept in solution, but when once dry on a slip

\* See page 30.

\* *Journ. Quekett Club.*

it undergoes no change, and shows, at least as far as my own observation is concerned, no deterioration after a considerable time. It is undoubtedly troublesome and expensive to prepare, owing to the quantity of alcohol required, but when once obtained a little of it goes so far that practically it costs but little.

'For use, a portion should be dissolved in distilled water to any required consistence, and passed twice through filter-paper, which should have been previously washed with distilled water. It may then be placed on the slips, drained, allowed to dry, and the slips put away for use. In this condition, and with ordinary precautions as to dust and damp, it may be preserved indefinitely.'

The objects that can be profitably mounted in the cells described in this article are innumerable. Foraminifera, polycystina, young oysters, young echini, zoophytes, polyzoa, leaves of plants with their wonderful hairs, wing-cases of beetles, crystals of many kinds; in truth, the list would soon grow too long to read. These few examples will be suggestive of many others, which are left for the reader to find and prepare.

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### A Home-made Revolving Table.

BY F. T. HAZLEWOOD.

In the December number is an article on a revolving table. I have made one in this way:—

I got a second-hand sewing-machine table, which can be obtained from dealers cheap. Then I took another table-top which was raised about two inches from the other by a moulding. On the top of the first table I put a piece of pine board one inch thick. Into this I put three small castors upside down. I bored three holes in the top of the other table, on radii, from a common centre. Then I put top No. 2 over top No. 1, so that the castors came above the surface about a quarter of an inch. Through the centre of both tables I bored another

hole. Then I took a steel saw plate into which the teeth had not been cut. I had a hole bored in its centre and two brass handles or pins put in opposite each other near the circumference. This plate I fastened by a pin with nuts on the table over the three castors. The table is perfect. I painted the steel plate. The drawer of the first table on the side serves for accessories. The whole thing cost less than five dollars. The finished table looks as though made for this purpose and not for a sewing-machine.

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## EDITORIAL.

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**Publisher's Notices.**—All communications, remittances, exchanges, etc., should be addressed to the Editor, P. O. Box 630, Washington, D. C.

Remittances should be made by postal notes, money orders, or by money sent in registered letters. Drafts should be made payable in Washington, New York, Boston, or Philadelphia.

Subscription-price before April 1st, \$1 per year, in advance. All subscriptions after this month begin with the January number. After April 1st the subscription-price will be \$1.50.

The regular receipt of the JOURNAL will be an acknowledgment of payment.

**STAINING WITH LOGWOOD.**—Dr. C. L. Mitchell has experimented to obtain a permanent and useful solution of hæmatoxylon for microscopical use, and his results are embodied in an article published in the *Proc. Acad. Nat. Sci.* of Philadelphia. Logwood is unquestionably an exceedingly useful coloring agent, but the solutions as usually made become cloudy and spoiled after a time. This objection to them has been removed by Dr. Mitchell, who prepares his solution, which he has named 'Mitchell's hematin staining fluid,' as follows:—

Place two ounces of finely-ground logwood in a funnel or percolator and allow water to percolate through it until the liquid that runs off is but slightly colored. Then drain thoroughly and spread it out on a paper or board to dry.

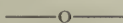
Dissolve nine drachms of potash alum in eight ounces of water, macerate the logwood in this solution for forty-eight hours in the percolator,



then draw it off and pour through sufficient water to make a solution of twelve ounces. Add four drachms of glycerin and preserve in a bottle.

By this method it is claimed that the tannin is nearly all removed from the logwood by the first washing with water. We are not prepared to believe, however, that the solution as thus prepared can be much if at all superior to that used long ago by Dr. Geo. D. Beatty, of Baltimore, for our own recollection of Dr. Beatty's solution is that it kept very well indeed. His method was to take half an ounce of ground logwood and one ounce of alum, grind them together in a mortar, then add five ounces of hot water, and after two days filter, and add two drachms of alcohol. In twenty-four hours the solution was again filtered, when it would keep, with occasional filterings, for two months.

If there is a decided advantage in removing the tannin matters by the preliminary treatment of the wood with water, this could be done and Dr. Beatty's method, which is practically the same as Dr. Mitchell's, but more easily carried out, could be then followed.



**NEGLECTED OPPORTUNITIES.**—For some reason microscopists, and, indeed, naturalists generally in America, seem to prefer work at home rather than searching the fields and woods and streams for their treasures of animal and vegetable life. It is different in England, where nature is studied out of doors by naturalists of all degrees of attainment, and there is no doubt the frequent field-days of the clubs and associations greatly add to the success and profit of the regular meetings. If we are not mistaken, there is a gradual change in this respect coming over microscopists here. Interest in pond-life seems to be growing. This is doubtless due in part to the fact that a few collectors have taken the lead and enabled others to become familiar with some

of the forms of infusorial life so abundant in all localities. The publication of Mr. Saville Kent's 'Manual of the Infusoria' has doubtless done much to increase the interest in this subject here as well as abroad. While Mr. Balen was sending out specimens in tubes by mail, many persons were enabled to study organisms they had never before seen. Mr. Bolton, in England, has greatly aided observers in the same way, and he has discovered many new forms which have been figured and described in his portfolio of drawings. Dr. A. C. Stokes has already, in the short time he has devoted to this subject, described several new species of the collared infusoria.

No words of ours are needed to point out the rich fields open for investigation to any one who will establish small aquaria at home and stock them with a few algæ and weeds from the ponds about, occasionally replenishing the supply with fresh collections. Nevertheless it seems that some urging is necessary to induce those who are capable of undertaking such investigations to give thought to the subject and to begin work. Almost nothing is known about the infusoria of any locality of the United States. Botanists are studying the phænogamous flora and the fungi of certain localities, and publishing lists of species found; but who are studying the algæ or the infusoria? Yet this JOURNAL, devoted to microscopy alone, has a circulation that is probably double that of any botanical journal published in this country.

What are microscopists doing in the way of useful observation? The pages of this JOURNAL show that some of them are at work to a good purpose, but the mass of them are neglecting the attractive fields now offered for valuable original observations. Considering the number of microscopists, it is strange that so little is known of the microscopic life of the country. It is to be hoped that these few words will serve to

lead the thoughts and energies of some of our readers to this subject, which cannot fail to be attractive to those who will begin the study.

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POSTAL CLUB BOXES.—Box F came to hand April 23d with five slides, No. 1 and the corresponding page of the letter packet having been removed.

2. Wheel-like Spicula of Chirodota from Bermuda. F. M. Hamlin. A good description and figure accompanies this dry-mounted preparation. There is an unfortunate condensation of minute drops beneath the cover-glass, which mars the original excellence of the mount.

3. Muscle-cells from Large Intestine of Cat. S. H. Gage.

4. Transverse section of Human Toe-nail. M. S. Wiard. The section is well cut by the method described, which was by clamping the specimen between two pieces of wood and using a carpenter's plane. It is not well mounted, being twisted, and is of no interest whatever to the club. The method of cutting might have been just as well illustrated by a more interesting object.

5. Section of Softened Dentine from Carious Tooth. A. M. Ross. This is an instructive specimen which deserves, and doubtless will receive, careful examination from the club.

6. Comb-like Appendage from thorax of Scorpion. John D. White. The preparer asks for information concerning the use of this appendage, which is well displayed on the slide. Mr. C. E. Hanaman suggests they probably serve some purpose in copulation, and refers to Owen's 'Lectures on Comparative Anatomy, etc.,' where he finds the following passage: 'The palpi of the scorpion take no share in the formation of the generative system in either sex; both male and female are provided with a pair of peculiar comb-like appendages attached directly behind the genital aperture.'

SWINE PLAGUE.—Considerable interest has recently been manifested in some quarters concerning the cause of the disease popularly known as swine plague. We give a brief summary of the course of the investigations by the different observers engaged in the work.

About the years 1876-7 Klein found what he described as a *Micrococcus* in the tissues, which he regarded as the cause of the disease. Afterward, in 1878, he found a *Bacillus*, which he cultivated, and used successfully in inoculation experiments. About a year later a *Bacillus* was also found by Detmers, of Chicago, who in the course of another year expressed some doubt about the *Bacillus*, but described rod-like organisms.

The Report of the Department of Agriculture for 1880 contains an account of the earlier investigations of Salmon, who there describes a *Micrococcus*, and in a later report he demonstrated the pathogenic nature of the *Micrococcus* by cultivations and inoculations, which, so far as we can discover, is the first satisfactory conclusion that was reached in these investigations; for all the preceding evidence was of an uncertain character as regards the specific organism producing the disease. In 1882 Pasteur and Thuillier also described a *Micrococcus*, cultivated it, and showed it to be pathogenic. Klein has recently endeavored to sustain his original opinion that the active organism of the disease is a *Bacillus*, so the question seems in a fair way of being opened once more for further investigation.

Concerning the identity of the schizophytes observed there has been some uncertainty on the part of at least one observer who at one time attributed his inability to decide the question to imperfections in the objective used, which was a Hartnack—a brand that is usually considered good enough for anybody. Some correspondence upon this subject has already been published in the second volume of this JOURNAL, pp. 37 and 57.



# DESMIDS OF THE UNITED STATES.

—We are glad to announce to the microscopical public the completion of this work upon which the author, the Rev. Francis Wolle, of Bethlehem, Pa., has been engaged for a long time. As we pen these lines the book is in the binder's hands, and will be soon ready for distribution. The work consists of 220 printed pages, including a carefully arranged index, giving a short account of algæ in general, and a fuller one of desmids, with directions how to find, collect, preserve, and examine them, a minute description of each of the 500 species named in the index, and a descriptive catalogue to every plate of the plants illustrated thereon. It contains 1,100 figures on fifty-three colored plates.

A more extended notice of this valuable work will be given at another time. The book is published at the author's personal expense, and we trust microscopists will show their appreciation of such enterprise not only by ordering immediately, but by sending their orders directly to Mr. Wolle and not to their booksellers or other agents, for reasons which must be obvious. The price is \$5.00.

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# AMERICAN SOCIETY OF MICROSCOPISTS.

—The announcement by the President, the Hon. J. D. Cox, of the next meeting of the Society has just reached us, and we select the following information from the circular:

The Seventh Annual Meeting of the Society will be held at Rochester, N. Y., beginning on Tuesday, August 19th, 1884, lasting four days. The time is set a week before the meeting of the British Association at Montreal; that of the American Association at Philadelphia occurring one week later still. We hope that we shall have the pleasure of welcoming distinguished men of science from the British Islands and from Canada, whose names are familiar to us from their valuable work with the microscope. The arrangements made by the local committees are such as to

ensure most agreeable and interesting sessions, with the most ample facilities for those who present papers to illustrate them by projection apparatus and otherwise.

Titles and abstracts of papers should be sent as soon as practicable to the Secretary, Prof. D. S. Kellcott, Ph. D., 119 Fourteenth street, Buffalo, N. Y.; and all who intend to be present or to join the Society are requested also to notify him or the local committee at Rochester.

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# —A NEW MICROSCOPICAL SOCIETY.

—There is a microscopical society in San Francisco composed entirely of ladies. We believe this because the secretary has written a letter to Mr. Crisp to tell him all about it. The microscopists of England now know that such a society exists and are doubtless delighted. But is it not a pity that microscopists here should be kept so long in ignorance of it? We think it is time the society should be known here, so we take the first opportunity to announce its existence to the American public.

We may also take occasion to say that as the society was apparently not aware of the existence of another ladies' society in the country until informed of it through Mr. Crisp's remarks, it may be fair to suppose that it is also unaware of the existence of any American microscopical literature; for no reader of this JOURNAL, at least, can fail to know of such an active organization as that at Wellesley College. As a matter of mutual interest, therefore, we shall by a special effort endeavor to make known to the society the peculiar merits of this publication, trusting the members will thereby learn, that, although they may look to foreign lands for styles and methods of personal adornment, when they come to such a serious subject as microscopy their wants can be as well met, and their fame as well appreciated, in their own country.

IMMUNITY AGAINST RECURRENCE OF CONTAGIOUS DISEASES.—Prof. Tyndall has presented his views on this subject, which, as they appear to be of considerable interest, we reprint from the *Pall Mall Gazette*:—

‘One of the most extraordinary and unaccountable experiences in medicine was the immunity secured by a single attack of a communicable disease against future attacks of the same kind. Smallpox, typhoid, or scarlatina, for example, was found, as a general rule, to occur only once in the lifetime of the individual, the successful passage through the disorder apparently rendering the body invulnerable. Reasoning from analogy, I have ventured to express the opinion that the rarity of second attacks of communicable diseases was due to the removal from the system, by the first parasitic crop, of some ingredient necessary to the growth and the propagation of the parasite.

‘The cultivation of micro-organisms, which is now everywhere carried on, enables us to realize the smallness of the changes which, in many cases, suffice to convert a highly nutritious liquid into one incapable of supporting microscopic life. Various important essays bearing upon this subject have been recently published in the *Revue Scientifique*. M. Bouley there draws attention to the results obtained by M. Raulin in the cultivation of a microscopic plant named *Aspergillus niger*. The omission of potash from Raulin’s liquid suffices to make the product fall to one twenty-fifth of the amount collected when potash is present. The addition of an infinitesimal amount of a substance inimical to the life of a plant is attended with still more striking results. For example, one part in 1,600,000 of nitrate of silver added to the liquid entirely stops the growth of the plant. And now we come to the important application of this fact which has been indicated by M. Duclaux. Supposing the aspergillus to be a human para-

site—living contagium—capable of self-multiplication in the human blood, and of so altering the constitution of that liquid as to produce death, then the introduction into the blood of a man weighing sixty kilograms of five milligrams of the nitrate of silver would insure, if not the total effacement of this contagium, at all events the neutralization of its power to destroy life. The index finger here points out to us the direction which physiological experiment is likely to take in the future. In anticipation of the assaults of infectious organisms, the experimenter will try to introduce into the body substances which, though small in amount, shall so affect the blood and tissues as to render them unfit for the development of the contagium. And subsequent to the assault of the parasite he will seek to introduce substances which shall effectually stop its multiplication. There are the strongest grounds for the hope that in the case of infectious diseases generally such protective substance will be found.’

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THE FIRST BACTERIA AND THEIR DISCOVERER.—The *Apotheker-Zeitung*, of New York, recently published an interesting letter written by Dr. Ferdinand Cohn, in which he says: ‘In the present time, when the times of great men and great events are so freely honored, it seems to me not inappropriate to call to mind that two centuries have passed since one of the most important discoveries was made in Holland. In a letter of the 14th of September, 1683, from Delft, addressed to Francis Aston, Fellow of the Royal Society, London, Antony Van Leeuwenhoek stated that he had discovered with his microscope living animalcules with most pleasing motion in the white matter adhering between his teeth.’ These were the first bacteria that a human eye had seen. Leeuwenhoek distinguished several species, which he described and figured so correctly that they may be still recognized without difficulty.



## NOTES.

—Work in seaside laboratories in summer is attracting many students and teachers, and the accommodations and facilities seem to be increasing every year. Probably the most thoroughly equipped and extensive of all is the establishment of the U. S. Fish Commission, at Woods Holl, Mass., where much zoological work is done every year. This, however, is not intended to give the instruction that can be obtained at such places as Annisquam on Ipswich Bay, near Gloucester, or at the Summer School of Johns Hopkins University, under the direction of Prof. W. K. Brooks. The Annisquam laboratory opens June 20th. Inquiries should be addressed to Mr. Alpheus Hyatt, Curator of the Boston Society of Natural History.

—Mr. Edward Lovett employs a cement for mounting objects in fluid, which is exceedingly hard and apparently as enduring as stone. It bears a high temperature, 140° F. in an oven, without permitting the enclosed fluid to escape. This cement is composed of 2 parts white lead, 2 of red lead, and 3 of litharge finely ground and mixed. For use a little of the powder is mixed with gold-size to the consistence of paint.

—At the meeting of the New-York Microscopical Society of April 18th, among the objects shown were samples of ramie brought by Mr. T. M. Letson, who gave a brief history of this fibre, and spoke of its apparently growing importance as a commercial product.

—Cover-glass has been hitherto made by Chance, in England, but there is an establishment in Germany now preparing to introduce a German cover-glass. Chance's cover-glass is made of ordinary crown glass, having a refractive index of 1.5 to 1.525.

—A correspondent writes to us in the following unusual, but to us quite refreshing words:—'I regret that American microscopists do not support the JOURNAL as they should. If it was a little more scientific would they not take hold of it more readily?'

It is truly refreshing to learn that some of our readers would like a more scientific journal. Why, already it is so profound, so theoretical, so much an organ of specialists, as to receive the disdain and ridicule of a professor in a Western college! Yes, an elementary scientific journal is held up to ridicule because it is too scientific by

a college professor! Yet an intelligent reader thinks it too elementary to be popular! Well, well!

The same correspondent writes:—'What a pity it is that your splendid *Quarterly* had to die! I have always greatly regretted that. Can't you revive it? I wish I were rich—I would like to help in that.'

Such words do one good, for they show that there is some appreciation of meritorious effort, even though not enough to give it adequate encouragement and support.

—It is stated in a Rio de Janeiro newspaper that Dr. Domingos Freire has discovered the contagium vivum of yellow fever, and that successful inoculations have been made in 211 cases, giving encouragement to the opinion that the disease may thus be prevented.

—Mr. T. Lisle writes, in the *Journ. Post. Micr. Soc.*, that Quekett's method of preparing the trachea of caterpillars with acetic acid is not satisfactory. He advises the following method: Cut off the head, make an incision down the back, and put it in a solution of carbonate of potash and lime, or of caustic potash. In three or four days the body becomes cheesy, when it may be turned out of the skin with a blunt knife. Boiling in potash then dissolves the mass, leaving the trachea floating in the liquid.

—Dr. J. E. Rombouts, in an article in *Popular Science Monthly* of this month, writes as follows:

'I have concluded from my experiments that it is not the pressure of the air nor the power of an adhesive liquid that gives flies the faculty of running over smooth bodies, but that the power should be attributed to the molecular action between solid and liquid bodies; or, in other words, to capillary adhesion.

'If we examine the under part of the pulvilli with a microscope, we shall see distinctly that it is furnished with numerous hairs, regularly distributed. These hairs terminate, at their lower end, in a kind of bulb, the form of which varies, whence flows an oily liquid that dries slowly and does not harden for a long time. The minute drops left on the glass by the hairs may be taken away, even after two or three days have passed, without our having to moisten them, by simply rubbing a piece of fine paper over them. I have devised an apparatus for collecting these drops by cutting a hole in a piece of board over which I fix a glass slide. Turning

the board over so that the glass shall be at the bottom, I have a little cell with a glass floor. With the aid of a piece of paper gummed to the wings, I introduce a fly into this cavity in such a manner that the pulvilli shall rest upon the floor. Then, putting the board under the microscope with the glass slide uppermost, we have the fly's feet under our eyes. The insect, struggling for liberty, places his pulvilli against the glass, and leaves after each effort traces that may be observed very distinctly, for they are perfectly visible in a good light.

'We may discover, whenever the feet of the fly come again into contact with these tracks or minute drops, that they are composed of a very liquid substance, for they spread quite readily on the glass. We cannot admit, as some naturalists assume, that the liquid can hold the club-shaped hair-ends by suction. If this were the case, the ends would change shape during the suction, and would take the form of a disk. The fly puts its feet down and lifts them up with an incomparable facility that would not exist if the limb were really acted upon by the pressure of the air.'

—The first editions of the catalogues of W. H. Walmsley & Co., embracing telescopes, spectacles, eye-glasses, and photographic cameras, lenses, etc., in three parts, have just come to hand, together with the fourteenth edition of the catalogue of microscopes and accessories of R. & J. Beck, which is issued by the same firm. All of these catalogues are carefully prepared, and a credit to the establishment. Among many excellent articles to be found in them we notice a developer for photographic plates which Mr. Walmsley has prepared and which he states to be the 'best and most economical developer in use.' This will doubtless be highly esteemed by those who apply photomicrography in their work. There is also a 'list of reagents for microscopic staining,' with directions for using them. All the forms of Beck's microscopes and accessories are figured in the catalogue, and in addition some of the stands made by the Bausch & Lomb optical company. We notice, also, that the labels for slides devised by Mr. I. C. Thompson, of Liverpool, are offered for sale in sets of a thousand.

—Mr. William Wales has changed his place of business in New-York, and will hereafter be more easily found by those who visit the city. He is now at 53 Nassau street, where he will keep on hand a full assortment of microscopes, accessories,

and objectives. We are pleased to learn that he has moved down town, and doubt not the change will be to his advantage.

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## CORRESPONDENCE.

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### Mailing Packages of Diatoms.

TO THE EDITOR:—I have been much interested in the past in practical articles on mounting. Wish there might be something on preparing fluid mounts. Have gained many valuable suggestions from the JOURNAL as to the minutiae of mounting.

Can you tell me, through the JOURNAL, how one can send small exchanges to foreign countries? There seems no limit to the vials of fluid as diatoms which one may receive from them. I have received as many as 20 vials in one box, but if I send one vial containing a few drops, even in a tightly corked wooden flask, it is returned to me from the New York post office stamped 'liable to injure and deface the mails.'

M. A. BOOTH.

[The only way to send specimens of diatoms in fluid abroad is to put letter postage on them. Abroad, post offices are established for the convenience of the people, to encourage intercommunication, and in Holland one can send butter, herrings, and perishable merchandise by mail, and even have the bills collected and the amounts returned for a trifling fee.

Let some one put a dried herring in the New-York post office, and see how far it would go! Our postal laws are absurd in many respects, but they would not be so bad if the officials saw fit to use discretion in interpreting them, instead of acting like automata.—ED.]

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## Exchanges.

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Exchanges are inserted in this column without charge, [They will be strictly limited to mounted objects, and material for mounting.]

Will exchange well mounted slides for others well mounted.

H. H. PEASE,  
1271 Broadway, N. Y.

Living red *Astasia namatodes* (*Euglena viridis*) and *Volvox* sent on application, or mounts of the same in exchange for algæ, fungi, or infusoria.

J. M. ADAMS,  
Watertown, N. Y.

Will exchange various mounts of crystals for other slides, and material for mounting.

JAMES E. WHITNEY,  
Rochester, N. Y.



# THE AMERICAN MONTHLY MICROSCOPICAL JOURNAL

VOL. V.

WASHINGTON, D. C., JUNE, 1884.

No. 6.

## Volcanic Dust.

Much has been written about the remarkably brilliant colors of the sky at sunrise and sunset observed several months ago, and speculations as to their cause were, as usual when anything remarkable occurs, numerous and often quite as surprising as the phenomena themselves. Strange to say, the explanation that seemed to meet with most general acceptance, that of volcanic dust, was one which very brief consideration would have shown to be quite untenable, while the most obvious and reasonable of all, which certainly must have immediately presented itself to the minds of meteorologists as it did from the beginning to ourselves, received but little prominence in the public press. The after-glows were probably caused by aqueous vapor in some form in the higher regions of the atmosphere; possibly by particles of dust of meteoric origin.

The subject, however, has drawn attention to the importance of microscopic examination of atmospheric dust, several specimens of which have been recently sent to the National Museum for this purpose, from widely-separated localities. Thus far nothing remarkable has been observed in any of them, but as the collections increase it may be hoped that interesting results may be obtained.

It is not unfrequently that dust is collected many miles from land on the sails of ships. Ehrenberg has recorded several showers of dust, containing infusorial remains, which must have been carried many miles in the air; and other observers have noticed the same phenomena. All

dust so collected is by no means of volcanic origin; frequently it contains infusorial remains, but in most instances it resembles the fine dust which may be taken up by the wind almost anywhere, and no indication of its place of origin can be found by examination. For example, we have recently examined the sediment from some discolored snow which fell in the vicinity of Rome, N. Y., last February. The discoloration was evidently caused by fine particles of dust which had been taken up from some unknown locality, and resembled what would be found on any dusty road in the country.

Since the eruption of the volcano Krakatau, specimens of dust have been collected in various parts of America and Europe which have been regarded as cinders from the volcano carried in suspension in the atmosphere. M. Renard, in view of the interest lately aroused in the subject, presented a verbal communication before the Belgium Microscopical Society, upon the microscopical characters of the volcanic ashes of the eruption of Krakatau. We condense from the *Bulletin des Séances* the following observations of M. Renard:

Although it is not difficult to decide upon the eruptive nature of volcanic specimens of sufficiently large size, one cannot affirm so positively concerning volcanic particles in the form of ashes. It may be said that it is neither the presence of volcanic minerals nor the structure of minute vitreous particles which enables us to distinguish the eruptive nature of dust from the atmosphere. Minerals reduced to such infinitesimal dimensions

and irregularly fractured as is the case in volcanic ashes, lose their distinctive characters. Their microscopic size does not permit their optical properties to be learned; their irregular and fragmentary form interferes with the determination of their characteristics. The phenomena of pleochroism, and the particular tint of the mineral, lose so much of their brightness that they do not serve for a sure identification. It results from our observations that a mineral having the characters of those composing volcanic ashes, cannot be certainly determined when its dimensions descend below 0.05 mm.; while the vitreous fragments are susceptible of determination even when their dimensions are less than 0.005 mm. The absence or rarity of crystals or fragments of volcanic crystals should not be considered a proof that pulverulent matter collected from the air is not of eruptive origin, owing to the sorting to which the particles are subjected after the eruption.

The most certain diagnosis of the volcanic nature is always found in the structure of the vitreous particles projected in the form of cinders. This special structure is seen in the fracture, and its imprint is found even on the smallest fragments, when the microscope cannot reveal other characteristic properties. To prove that these characters of vitreous volcanic materials remain constant even to the ultimate limits of pulverization we have ground in a mortar diverse varieties of pumice. The powder thus obtained was extremely fine, nevertheless its infinitesimal particles still showed the distinctive features of which the ashes of Krakatau gave such a perfect demonstration. The diagnostic character to which we allude is not the extraordinary preponderance of the vitreous substance; but the great number of gaseous bubbles imprisoned in the pumice and in the vitreous portion of the ashes. These bubbles of gas are due to the expansion of gas dissolved in the magma,

and which causes the eruption. Admitting that these incoherent volcanic products are derived from the pulverization of a fluid magma, one understands that these particles are rapidly cooled, remaining in a vitreous state, and that the dissolved gas by expansion forms numerous pores, which, owing to the method of projection, assume a drawn out or elongated arrangement. The existence of these bubbles or of this filamentous structure, therefore, affords the means to discern the volcanic nature of these particles despite their condition of extreme division. It is also their porous nature that permits them to be transported such great distances.

Vitreous fragments of a brown color are quite rare in the ashes from Krakatau; those of a deeper tint enclose magnetite. In a general way it may be said all the crystals except those enclosed in vitreous matter are broken. The minerals of the ashes of Krakatau that are capable of positive determination are plagioclase, angite, rhombic, pyroxene, and magnetite. In proportion as the ashes are distant from the volcano, the ashes become less rich in minerals.

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### Lighton's Immersion Illuminator.

The following extremely simple plan for an immersion illuminator was first brought to the notice of microscopists a few years ago, and, in the absence of the inventor, was kindly described by Prof. Albert McCalla at the meeting of the American Society of Microscopists at Columbus, O. It consists of a small disc of silvered plate glass *c*, fig. 20, about one-

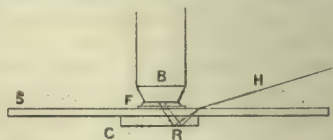


FIG. 20.—Lighton's Illuminator.

eighth of an inch thick, which is cemented by glycerin or some homogeneous immersion medium to the



under surface of the glass-slide  $s$ . Let  $r$  represent the silvered surface of the glass disc,  $b$  the immersion objective,  $f$  the thin glass cover. It will be easily seen that the ray of light  $h$  from the mirror or condenser above the stage will enter the slide and thence be refracted to the silvered surface of the illuminator  $r$ , whence it is reflected at a corresponding angle to the object in the focus of the objective. A shield to prevent unnecessary light from entering the objective can be made of any material at hand by taking a strip one inch long and three-fourths of an inch wide and turning up one end. A hole of not more than three-sixteenths of an inch in diameter should be made at the angle. The shield should be placed on the upper surface of the slide so that the hole will cover the point where the light from the mirror enters the glass. With this illuminator Möller's balsam test-plate is resolved with ease, with suitable objectives. Diatoms mounted dry are shown in a manner far surpassing that by the usual arrangement of mirror, particularly with large angle dry objectives.

WM. LIGHTON.

OTTUMWA, Ia.

### The Wine Fly.

On the fifteenth of February the New-York Microscopical Society held an open meeting to hear a paper by Dr. Samuel Lockwood, secretary of the New Jersey State Microscopical Society. His subject was the Wine Fly, *Drosophila ampelophila*. The paper was a contribution to the life-history of this minute insect. He had given in part three years to its study, beginning in September, 1881, when nothing whatever of its life-history seemed to have been known. In October the flies attacked his Concord. He found upon a grape which he was inspecting with a pocket-lens an extremely small white egg, but lost it. The grapes

when brought on the table were infested by the flies, which proved to be the above-mentioned species. When driven from the grapes they would fly to the window, where he captured two of them. These were placed in a jar, with a grape for food. In two days he found one egg on the outer skin of the grape. The laying was kept up for four or five days, until there were about thirty, some on the outside of the grape and some at an opening where the two flies had fed. The egg had a pair of curious suspenders near the end where the mouth of the larva would develop. These suspenders were attached at their ends to the grape, but where the egg was laid in the soft part of the fruit the suspenders were spread out at the surface; thus the larva would emerge clean from the shell. The egg was 0.5 mm. in length, and about a fourth of that in width. The larva when grown was at least four times as long as the egg. As the larva burrowed in the juices of the fruit two quite prominent breathing tubes at the posterior end were kept in the air. Between these cardinal tubes were several teat-like points, much smaller, but having a similar function.

The larvæ appeared in five days after the eggs were laid. In about as many more days the puparium state would be entered, and in about six days more the fly or imago would appear. In ovipositing the suspenders would leave the oviporous duct last. The paper claimed that the curious shape of the egg compelled the female to oviposit slowly, as it took time for the egg to assume its form; hence, the eggs were not laid in strings or masses, but singly and at considerable intervals.

The flies are very hairy, especially the females. The neck and even the eyes are very hirsute. The eyes are red, quite large and pretty, though somewhat *outré* under the microscope, for from between the little lenses are projecting, straight, stiff

hairs. As the insect is quite active it must be that this fringing of the tiny eyelets with hair does not materially obscure its vision. When the minuteness of this singular arrangement is considered, it is surely remarkable. This general hairiness of the female especially, and that about the head, neck, and forward part of the thorax, stands correlated to a beautiful structure found only in the male, which has on the tarsus of each leg in the forward pair what the lecturer called a sexual comb. It is a beautiful comb of a very dark brown color, each comb having ten pointed and strong teeth. In the nuptial embrace these combs are fixed in the hairy front of the thorax of the female, thus becoming little grapnels.

The flies love any vegetable substance in fermentation, whether acetic or vinous. Hence it will abound about cider mills, swarm on preserves in the pantry, and in cellars or places where wine is being made or stored. The paper showed the tendency of the glucose in the over-ripe grape to the vinous ferment, and that the fly delighted in it. A singular accident showed how they loved even the very high spirits. In making some of the mounts shown to the society Dr. Lockwood had left a bottle of 90 per cent. alcohol uncorked over night. Next morning he was astonished to find his alcohol of a beautiful amethystine color, and the cork out. Inspection showed a number of these tiny creatures which, when filled with the purple juice of the grape, had smelt the alcohol in the open bottle, and had gone in to drink. They had ignominiously perished, and had given color to the liquid.

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## Structure of the Diatom-shell.—

### IV.

BY JACOB D. COX, LL. D., F. R. M. S.,  
PRES. AM. SOC. OF MICR.

In studying the naviculæ we begin with the large *Pinnularia*, where the size of the valves and the simplicity

of the marking make easy the application of the criteria we have already established. Using transmitted light, the raphe is found to show the color of the general background, whilst the smooth longitudinal portion of the valve next it is tinted with the pink color which indicates thickening of the siliceous. The central nodule shows this in a higher degree, with lenticular effects. The costæ are pink in tint also, and in large specimens of *P. major* the interspaces between the ribs are often divided into what appear to be two large oval depressions, of which that next the midrib is the shallower, as is shown by its excess of color over the outer one. The central nodule often extends considerably beyond the inner end of the median line, which is a little enlarged, and seems to terminate in a circular dot, which, by its bright light and freedom from color, should be a depression reaching nearly or quite through the nodule. In a specimen of *P. alpina* from a Scotch gathering I have found a valve turned partly on one side, so as to give an obliquely transverse view through the valve, and in this the enlargement of the median line is plainly seen to extend like a tube through the thick prolongation of the central nodule. It is not uncommon to find broken valves of *Pinnularia* in which the costæ project boldly beyond the interspaces of which the thin film has been partly broken away. I have noted a specimen of *P. divergens* in which the thin film has been almost wholly removed by some accidental grinding process, and the costæ stand out along each side like the teeth of a comb. Prof. H. L. Smith has given me another similar example of *P. major*. The raphe appears to be a channel having a very thin film at the bottom, which is part of the firm siliceous on one side, and laps under the other side in a way similar to the 'rabbet' in joinery.

Of the dotted naviculæ, *N. lyra* may fairly be taken as the type. Its beautiful regularity of form and the



clearness and boldness of its marking make it a very profitable subject for careful examination. It is easy to get somewhat varied appearances by different uses of the light and changes of focus of the objective, but if we use the narrow central pencil of light and care in focussing, its characteristics will be found uniform and unmistakable. Its lyrate hyaline figure in the middle of the valve takes the pink tint. The dots are found to be between costæ which are fully as wide as the dotted interspace, and these have the same color as the lyrate figure. Find a broken shell and focus carefully upon the broken margin. Oftentimes the costæ will be found to project beyond the interspace, showing its greater strength, and confirming the evidence to this effect which is found in its deeper color. When the focussing gives us the costæ as well-defined ribs of even width, and a broken edge is also most sharply defined, the dotted interspace will approximate to a ladder-like appearance, the dots having a sub-rectangular form, and being separated from each other by septæ considerably narrower than the costæ between which they lie. The term 'sub-rectangular' which I have used must not be taken too literally, for the figure of the dots is that of a circle somewhat flattened on four sides. Assuming that the median line is a groove in the valve, and focussing upon it so that the light coming through it shall correspond nearly to the general field, it will then be found that the dots nearest this line and most perfectly in the same plane show the same color—an item of evidence that they, too, are thin places in the shell. But the line of fracture gives still stronger proof. I have before me a broken valve of *N. lyra*, in which a segment is entirely gone, bounded by the median line for, say, half the distance from the end of the shell to the central nodule. Then the broken margin runs irregularly off to the rim of the shell. On the other side a wide

crack extends diagonally from the median line a short distance, then runs straight out to the rim. This crack (examined with a  $\frac{1}{18}$  objective) zigzags through the dots in the first part of its course, and in the straight part runs indisputably through the dots and between the straight costæ. The broken edge of the other side of the shell shows with equal clearness that the fracture is through the dots. I have many such cases noted, with great varieties of fractures, but all indicating the same fact in regard to the structure, viz., that the dots are the thin and weak places in the valve.

Another point to be noted is that whilst the radiant costæ of *N. lyra* are straight, making also straight transverse striation when viewed with a low power, the longitudinal septæ between the dots are not regularly continuous; consequently when light is thrown transversely across the shell a low power shows longitudinal striæ, but wavy instead of straight. This is also the case with the striation of *N. firma*, *N. cuspidata*, *N. rhomboides*, and *Frustulia Saxonica* when examined with high powers, and with the *Nitzschias* of the form of *N. scalaris*, *N. linearis*, etc., of which the coarser specimens show distinct lines of punctæ between parallel costæ. It is characteristic, too, of the difference between the transverse and longitudinal striæ of *Surirella gemma*. It is certainly natural to conclude that the similar phenomena are due to similar structure.

In naviculæ having strongly radiant costæ, some, like *N. peregrina*, show a similar dotted structure between the ribs, and in these cases the lines of separation between the dots are also much finer and less prominent than the costæ. In another class of naviculæ, of which *N. sculpta*, Ehr., is an example, the dots, whilst arranged in lines, do not have thickened costæ between the rows, but are like separate, sometimes elongated, punctæ in a shell of even thickness. In these, however, as in *N. lyra*, the line of

fracture follows the dots, and the hyaline parts of the valve show the pink color, so that both lines of proof still combine to show the dots to be the weak and thin places in the valve. A beautiful example of the latter sort is *Mastogloia angulata*, Grunow, which is not uncommon in Long Island Sound, and is found along the whole Atlantic coast. The shell is broad ovate, somewhat cuspidate, of smooth even thickness, and the punctæ are arranged in oblique rows. With a medium power the effect is that of a delicate cross-hatching, much like that of *Pleurosigma angulatum*. With a high power the dots are well separated, and, except as to arrangement, their appearance is similar to those of *N. sculpta*. As in the disc forms, the diminishing size of the areolæ brought us gradually very near to the fine lines of *Hyalodiscus subtilis*, so among the naviculæ we make a similar approximation to the delicate marking of the pleurosigas.

The use of the vertical illuminator upon these diatoms is hardly less decisive in support of the conclusions I have drawn than in the case of the coscinodiscæ. A smooth surface dotted with tiny bubbles is the characteristic appearance of the shell, and these bubbles in the larger kinds cannot be distinguished from those which we have found in the disc forms, beginning with examples from the Nottingham earth where the hexagons and round areolæ were found side by side upon the same valve. We may even take a step in advance. In Peticolas' slides of Richmond and Petersburg earths there are numerous examples of a coarse form of *P. angulatum*, var. *Virginicum*, in which the marking in the middle of the valve is coarser than at the extremities. On dry specimens of this shell a high power used with the vertical illuminator will separate the dots sufficiently to show a surface hardly to be distinguished from that of *Mastogloia angulata* which I have noticed above. It is a smooth film in which the mi-

nute bubble-like dots have the same character and differ only in size from those in *Actinocyclus*, or in the coarser smooth naviculæ. In some broken specimens, also, the line of fracture could be traced through the dots.

In *Stauroneis pulchella* the areolæ are much longer in proportion to their width, and are contracted at the ends so as to take the 'oat-shaped' appearance by which they are commonly known. There is here found a difference in the appearance of the concave and convex sides of the valve, the former presenting the areolæ more nearly as rectangles, and the latter giving more of the spindle shape. This is analogous to the difference noted in other genera, the outer view of hexagonal markings being usually nearly circular, whilst the inner shows the angles more clearly. In *Epithemia turgida*, as found in Möller's preparation from the Södertelge mud, the frame-work of the shell is a nearly rectangular lattice, the areolæ showing all the peculiarities of light which have been described in *Navicula lyra*, and the fracture often shows the ends of the frame-work sticking plainly out beyond the sides of the adjacent dots. The same may be seen in the elongated areolæ of *Amphora ovalis* of the larger varieties. In *Cocconeis splendidum* the hexagons are as distinctly formed as in *Coscinodiscus*, and in *C. scutellum* the areolation varies from coarse to fine with the diminishing size of the valves, giving a series analogous to that which are found in *Coscinodiscus subtilis*, and one in which the fracture is as plainly through the dots, whilst the evidence of relative thickness or thinness of the siliceous film from the color is as we have found it in other cases.

But to complete the list of species in which I have found the tests of fracture and of color supporting the theory of areolation of the diatom-shell, and contradicting that of solid spherules, would be too much like



making a catalogue of all in which the details are large enough to give a well-defined outline to a broken edge. In the progressive series of fine markings we sooner or later reach the point where the thinness of a film causes it to be lost in the general background of the field, or when the prismatic edge of a fracture makes diffraction enough to fringe it with lines of color or of apparent shadow, which make every cautious observer hesitate to affirm whether the boundary is in or beyond one of the striæ. The fringes move with the slightest motion of the fine adjustment of the microscope, and the interpretation of what we see is more or less modified by the preconceived theories of the observer. I have intended to draw my examples of facts from specimens found clearly within this limit of doubtful discrimination. I am myself satisfied that in the coarser specimens of different species of *Pleurosigma* careful illumination and accurate adjustment of good lenses show the same characteristics of structure at broken edges of shells which I have described in the larger and bolder forms. In regard to this, however, I admit there is room for dispute. In the matter of the color-test, on the other hand, the evidence seems to me clear. If the objective is well adjusted, and the median line is brought into focus so that it appears a greenish white line of nearly the same tint as the general field, the dots which are near enough to it to be in the same plane are found to have the same color. In *Pleurosigma formosum*, *P. balticum*, *P. attenuatum*, and the varieties closely allied to each, the reticulation seems to be thickened upon the outer edges of the lines, so as to leave a cup-like depression in the interstices, which is yet consistent with double laminæ below. We have seen that in *Eupodiscus* this thickening becomes so great as to be quite opaque. In *Aulacodiscus Oregonianus* and in *A. orientalis* it is sometimes found thick

enough to give a decidedly dark color to the reticulation of the surface. In media of higher refractive index than balsam this becomes still more noticeable. In the pleurosigmas I have named I think a similar thickening of the lines (much more delicate, but real) has taken place, and that this gives the strong cross-hatching which marks them. In the varieties more closely allied to *P. angulatum* the shell is smoother, and in some of these the surface, with high magnification, and both by transmitted light and under the vertical illuminator, is found to resemble very closely that of the distinctly areolated forms which have been described.

In conclusion, I will notice briefly a few of the less regularly marked diatoms, but which still seem to me to corroborate the view of their structure which I have maintained.

In a group of species allied to *Navicula prætexta*, Ehr., including *N. Henedyi*, *N. Indica*, *N. clavata*, etc., the regular striæ are confined to narrow bands at the margin and along the median line, the intermediate space being either hyaline or mottled in varying degrees of distinctness. Specimens which have this mottling most distinct exhibit it as a system of rather large but faint dots, arranged in lines continuous with the distinct striæ at the margin, etc., but the dots in these lines are irregularly spaced as to distance. Occasionally an individual is found in which the dots are as sharply defined as in any of the smooth naviculæ, and giving the proof that they are areolæ by fracture and by color. Arranged in a series, therefore, they show us that the diminishing distinctness of marking is due to the progressive shallowness of the depressions in one of the laminæ of the valve, until from faintest mottling the dots disappear entirely, leaving the interior space smooth and hyaline.

The study of these last assists us in understanding the marking of *Helio-pelta*. In this splendid shell we have, first, an outer lamina or film, finely

punctate, making the appearance of diagonal cross-hatching upon each of the undulating segments. This film is sometimes found partially separated from the under one, much as the laminae of *Coscinodiscus* are found. In the Nottingham and Calvert County earths I have found this separation extending over part of a segment of the shell, a whole segment, two or three segments, and in one instance the whole valve. In this last case the separate outer lamina is not distinguishable from the figure given as *Actinoptychus pellucidus*, Grun., by Van Heurck, and I cannot doubt that this latter is a separated plate of a similar valve. The separation has included the central hyaline star figure in the shell as well as the dotted part, showing that the laminae exist here also, notwithstanding the homogeneous transparence of this part of the valve. In the second place, the inner lamina is found to have a different marking in the undulating segments. Those projecting outwardly from the face of the frustule are areolated with a sub-hexagonal areolation, quite distinctly defined. Those which are depressed have usually a much shallower sculpture of which the normal marking is a hexagonal arrangement of large shallow dots, but these are sometimes enlarged into a system of more distinctly marked equilateral triangles combined, so that the six form a regular hexagon. The difference between the deeper and shallower areolae in this case is similar to that which has been described in *Navicula prae-texta*, etc., and when they are covered by the lace-like veil of the finely dotted film we have the beautiful and changeable effect which has proven so puzzling to observers. In whole valves of *Heliopelta* the larger areolae will often be found showing in the central part of the shell where the fine dotting of the upper film does not extend over them, and their character may there be pretty satisfactorily determined, even if the separated laminae are not detected.

Since this article was in type I have received from Mr. Thomas Christian, of Richmond, Va., a slide containing a valve of *Triceratium favus*, which, whilst he was endeavoring to pick it up, split into two films, the inner with its marking of dots in radial lines wholly separating from the outer, which has the deep hexagonal cells closed with the exterior film with marking of eye-spots. The inner film has also the outline of hexagons upon it, being the mark of the attachment to the hexagonal cells. In this it differs from *Heliopelta*, in which the dotted film shows no mark of connection with the hexagonal areolae below. Mr. Christian's specimen of *Triceratium* is the first example of the entire separation of the laminae which I have met in that species.

In *Halionyx* a similar structure is found, but in the alternate segments the irregularity of sculpture of the inner lamina of the shell is carried further. It now has no geometric arrangement of areolae, but these are shallow and of irregular shape, yet so adapted to each other as to produce a general harmony of effect that is very beautiful, especially when seen through the veil of the regular and finely-dotted film above. In some varieties a strong hyaline radial line extends more than two-thirds the way from centre to margin in the alternate segments, and that this is stronger than the dotted part is proven by its being often found, in broken shells, projecting boldly beyond the rest of the fractured film. In similar examples the fracture, through even the finer dots, is demonstrably plain, and this last as well as that of color determines the agreement of both *Heliopelta* and *Halionyx* with the general law of structure which I have attempted to develop. The other species of *Actinoptychus* are strictly analogous to the two described.

The effect of shallow sculpture of the shell is seen also in many of the melosireae when radial lines and dots



not reaching distinctness and definiteness of outline make the ornamentation of different species. Thickened dots are also sometimes met, and by the deeper pink color which marks them are easily distinguished from and contrasted with the areolæ with which we have chiefly had to do.

The extreme of irregular sculpturing is met with in such forms *Stephanogonia Danica* in the Jutland cementstein, where all resemblance to the more ordinary marking of diatoms is lost.

As a summary of the results of my numerous observations of which typical examples have been given, I would say that we find the following conclusions warranted:

1. The diatom shell is usually formed of two laminæ, one or both of which may be areolated, and may be strengthened by ribs which have been described both as costæ and as canaliculi.

2. The normal form of the areolæ is a circle, and these when crowded together take a hexagonal and sub-hexagonal form.

3. The areolæ are properly pits or depressions in the inner surface of one of the laminæ, so that when two laminæ are applied together the exterior surfaces of the shell thus formed are approximately smooth and the cavities are within.

4. The apparent thickening on the exterior of the lines bounding the areolæ in some species, as *Eupodiscus argus*, etc., is not in contravention of, but is in addition to, the formation above described.

5. However fine the dotted marking of diatom valves may be, the evidence from the color of the spaces between the dots and of the dots themselves supports the conclusion that they follow the analogy of the coarser forms in which both fracture and color are found to prove that the dots are areolæ and the weaker places in the shell.

## Microscopical Technic.

### V. MOUNTING IN GELATINOUS AND RESINOUS MEDIA.

As these articles continue we receive occasional inquiries and suggestions which indicate that they are of interest to many readers. To the writer such communications are of no little assistance, for they show what kind of information is desired. We cannot undertake to answer so many inquiries by letter, but the subjects are duly noted, and will receive attention in their proper places.

#### *Mounting in gelatinous media.*—

Under this head are included such media as glycerin-jelly, Farrant's medium, Deane's medium, etc. All of these consist essentially of various proportions of glycerin, gelatin, and water. They are useful for mounting delicate tissues, being intermediate between water and Canada balsam in refractive power, and they require but little heat in use. We would be glad to see them more generally used instead of balsam. In our own work but little use has been made of them, for the reason that we have preferred mounting in fluid media—water or glycerin, or mixtures of the two. However, every one has his preferences, and it seems very strange that methods which prove entirely successful with one person do not succeed with others. It is natural, therefore, that while we have preferred fluid mounts, many others will prefer glycerin-jelly. The results are about the same, although in using fluids the preparer has a wider range of selection in choosing the mounting media for different objects. This subject will be brought up again in its proper place. We have now to describe the method of mounting in glycerin-jelly, which may be taken as the type of these gelatinous media.

The more delicate objects, if transferred from water directly to the medium, would become shrunken and the parts more or less distorted. Hence it is advisable to place them

first in a fluid of intermediate density. Such a fluid is readily prepared by mixing water and glycerin in various proportions to suit different objects, but the best plan of all is to transfer the specimens from water to a few drops of a mixture composed of water 2 parts, glycerin 1 part, alcohol 3 parts, and leave it exposed to the air but shielded from dust in a watch-glass until most of the alcohol and water have evaporated. In this way the density of the solution slowly increases until it becomes approximately the same as the glycerin-jelly. The objects may then be transferred to the latter medium without fear of shrinking or any change of form.

When mounting in cells there is no difficulty about placing the cell in the centre of the slide, for the turn-table aids in that. In mounting in glycerin-jelly or in resinous compounds, it is not usual to work with cells, and it is therefore well to mark the centre of the slide with a small dot of ink or color from a brush. With a self-centering turn-table this is very quickly done; but perhaps it is just as well to do it in this manner: rule a space three inches by one on a white card and draw diagonal lines from the four corners. These lines cross at the centre, and by placing the slide over the lines the centre can be instantly marked. In mounting be sure the dot is on the lower surface of the slide, so it may be cleaned off when the work is done.

Having centered the slide, the glycerin-jelly is warmed slightly, either over a lamp or by standing the bottle in warm water, when it liquifies and is ready for use. Place a portion on the warmed slide, transfer the prepared object to it, and be sure that no bubbles of air are likely to be included with the specimen. Then take a clean cover-glass in the brass forceps, warm it slightly and place it over the specimen, pressing it down gently. Should there not be sufficient of the medium to fill the space beneath the cover, more may be applied at the margin

of the cover, when it will run in and fill every part. On cooling the jelly will set, and may soon be cleaned off the slide around the cover, using first a knife, afterward a cloth and cold water. It is well to dry the jelly somewhat at a temperature of about 125° F. before finishing the mount.

The jelly does not become hard enough to be trusted without some protection. It is therefore necessary to use a cement, which should be ornamental as well as useful. Simple shellac or Bell's cement may be used, and either of these may be colored by any of the anilin colors. Over the shellac asphalt is frequently applied, and this makes a rich finish; but perhaps the neatest finish for mounts of this kind is a border of some clear, colorless medium, such as dammar. The cement should be applied in a narrow ring which extends only far enough over the edge of the cover to hold it securely.

Occasionally it is desirable to use glycerin-jelly for mounting an object which is so thick as to require a cell or some device for supporting the cover-glass above it. In the absence of a cell an object not too thick may be mounted with three pieces of cover-glass cemented to the slide with balsam so as to sustain the cover-glass. The pieces of glass are scarcely visible in the finished mount. Cells of glass may be used, or what is more convenient, shellac cells made with thick bleached shellac or with benzole balsam, built up in the manner to be described under mounting in fluid media. The cell properly prepared it should be first filled with the jelly and no air-bubbles should be left in it. The object is then transferred, properly arranged, and the cover applied as before described.

We have not deemed it necessary to enter into detailed instructions to meet every occasion that may arise in mounting. These articles are intended to open the way for the beginner, and it is to be presumed that any person who undertakes to mount ob-



jects for the microscope will quickly pick up numerous little 'dodges' which would only make these articles confusing should we attempt to describe them. The great fault in most books on mounting seems to be that the instructions are given too much in detail. Cements are described and recommended which the authors perhaps have never seen, and methods which no practical worker would spend the time to carry out. We prefer to write only of what we have tried and know to be satisfactory. It will be observed that we have not given any elaborate method of cleaning cover-glasses. This is because the simplest method of all, rubbing with a soft cloth between the fingers, is quite sufficient. This is rank heresy—but it is true nevertheless.

Among the objects well suited for mounting in glycerin-jelly may be mentioned delicate vegetable tissues, sections of plant-stems or leaves, vegetable fibres, algæ, pollen-grains, delicate insects mounted whole without pressure, and numberless other objects. In fact this medium is more universally adapted to mounting than Canada balsam, which is much more frequently used. The reader may compare the two media—glycerin-jelly and balsam—by mounting a thin longitudinal section of a match in each, and placing the two preparations under the microscope. The advantages will be clearly seen in favor of the jelly for such specimens.

*Mounting in Resinous Media.*—Canada balsam is the one medium most universally used of all the resinous compounds known. A number of others have been recommended from time to time as substitutes for Canada balsam, but of these only gum dammar has yet been largely used. Storax bids fair to come into use for certain purposes.\* As all the resinous substances are used in the same way, only Canada balsam will be particularly referred to here.

Objects to be mounted in Canada balsam must be specially prepared in order that the balsam shall thoroughly permeate them. Only very thin specimens which have no tendency to retain air within their pores or reticulations can be prepared by thorough drying alone. In all cases it is well, even with such specimens, to first saturate them with a drop of spirits of turpentine, and then apply the balsam. The turpentine penetrates every part of the object, and the balsam follows it readily. There are many objects, however, which retain the air so obstinately that when once they are dried it is almost impossible to remove it. This will be found the case with many sections of vegetable growths, but especially with preparations of insects. Such specimens must not be allowed to become dry, but the water which they contain, which does not mix with balsam, must be removed in another way. Ordinarily it can be successfully done by means of alcohol. Place the preparation in common alcohol and allow it to remain for several hours. Then transfer it to strong alcohol,\* which removes the water so thoroughly that the preparation may be placed in oil of cloves without causing turbidity. Oil of cloves, oil of cajuput, or eucalyptus oil may be used. They clear the specimens and replace the alcohol. In a short time, depending upon the density and size of the specimen, the oil will have penetrated every part, when the specimen may be placed upon a slide and mounted in balsam in the manner to be described further on. The usual practice is to transfer specimens from oil of cloves to turpentine or benzole before putting them into balsam. Some objects, especially sections of plants, shrink badly in either of these media, and it is quite possible to mount them di-

\* English books say 'absolute alcohol,' but this is not necessary, and in conversing with preparers in England we learned that they applied the name absolute alcohol to strong alcohol.

rectly from the oil, but in doing so as much of the latter as possible should be removed with bibulous paper.

(To be continued.)

## EDITORIAL.

**Publisher's Notices.**—All communications, remittances, exchanges, etc., should be addressed to the Editor, P. O. Box 630, Washington, D. C.

Remittances should be made by postal notes, money orders, or by money sent in registered letters. Drafts should be made payable in Washington, New York, Boston, or Philadelphia.

Subscription-price before April 1st, \$1 per year, in advance. All subscriptions after this month begin with the January number. After April 1st the subscription-price will be \$1.50.

The regular receipt of the JOURNAL will be an acknowledgment of payment.

—The delay in publishing the JOURNAL this month has been caused by the absence of the editor, who was called away early in the month by the death of his father. Proofs did not reach him as expected, and could not be read until the 15th instant.

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**PHOTOGRAPHS SHOWING THE STRUCTURE OF DIATOM-SHELLS.**—We have received thirteen very excellent photomicrographs made by the Hon. J. D. Cox to illustrate some points embodied in his articles on the structure of the diatom-shell, the last of which is published this month. These photographs are from what he designates the 'broken-shell series.' All were taken with a  $\frac{1}{16}$  of William Wales. They seem to fully sustain the arguments of the author of the articles, several of them in a very striking manner. Thus, in two of them (Nos. 21 and 22) the dotted film of *Coscinodiscus oculis-iridis* projects beyond the hexagonal walls at the line of fracture, and the broken edge of the film can be seen. On two other cards (26 and 27) we find the film with its dots, in fragments of *Triceratium* and *Heliopelta* respectively, the latter being especially striking, showing the dotted film extending fully an inch from the hexagonal structure at the line of fracture. The series includes fractured shells of other genera, *Odontodiscus*, *Epithemia*,

and several species of *Navicula*, all of which tend to demonstrate more or less clearly the imperforate nature of the diatom-shell.

We are not aware that photography has been hitherto employed to sustain facts of observation of this nature. In this case it proves to be of great value, since it shows clearly what has been seen, and enables others to verify statements which otherwise might be unsatisfactory or unconvincing to those holding other views concerning the structure of the shells. We have now evidence that must receive careful consideration, and which can only be overthrown by evidence of the same kind, which demonstrates in the same clear manner any errors or misinterpretations of the work before us, which is now offered to the microscopical world for critical examination. The photographs were made with magnification ranging from 650 up to 1600, and are very clear and sharp.

Since writing the above, six more photographs have come to hand, two of which deserve special mention. A broken frustule of *Navicula granulata*, Breb., mounted dry, shows the broken edge with extreme clearness, but the most interesting, and perhaps the most valuable photograph of all in throwing light upon the subject, is one taken from a *Pleurosigma angulatum*, W. Sm., of Calvert county, Md., deposit, mounted in balsam by Mr. Peticolas. In this the fractured edge shows the break through the dots, and the indented margin, with remarkable clearness, considering the fineness of the markings.

— o —

**KILLING AND PRESERVING DELICATE ORGANISMS.**—We have already several times mentioned the use of perchloride of iron for killing minute animals for mounting, and it seems to be coming into favor. In the *Journ. R. Micr. Soc.* we find a further notice of experiments by H. Fol, who has used the reagent very suc-



cessfully for some time. For ordinary use a solution in alcohol containing about two per cent. of the compound is about right, but when a large number of organisms is to be killed in a large vessel, the solution should be stronger.

The animals fall to the bottom, and the water should then be drawn off above them. Fol then adds some seventy per cent. alcohol, and replaces this in turn with alcohol slightly acidified with hydrochloric acid, which removes all trace of the iron salt. This should be immediately drawn off and pure alcohol added (probably no alcohol stronger than seventy per cent. is used, although it is not so stated).

It is said that the animals are thus fixed very perfectly in their expanded, living condition, and that the results are better than with picro-sulphuric, osmic, chromic or acetic acids, or with corrosive sublimate.

—o—

THE POSTAL MICROSCOPICAL CLUB.—The notices of the boxes which have appeared in these columns regularly this year have been given with a definite purpose aside from that of merely recording what they contain. It seems as though the club has the facilities for spreading information abroad in a manner that should prove, and can be made to prove, of great value to a large membership. We have observed with great satisfaction the systematic manner in which the details of work have been conducted by the present officers. Probably few of the members fully appreciate how much is due to their efforts, which have been made, we are sure, at no little sacrifice of time, not to speak of the labor involved. The affairs of the club are very ably managed. The value of its work is now absolutely dependent upon the contributions of individual members. The purpose of these articles is partly, and we may say mainly, to improve the quality and general

character of the work done by members of the club.

The notices thus far given have been more or less critical. Such criticisms as have been offered have been impartial, and commendation has been freely given when deserved. We would have it known that every person who contributes a good mount will receive the credit due for it in these columns. But among the slides that reach us too many are unworthy of acceptance by the club. This is frequently not because the contributors are unable to send better ones, but because they are unwilling to do so. It is said that inferior preparations should be received because the object of the club is to foster a taste for microscopical work, and beginners should be encouraged to contribute according to their abilities. Far be it from us to say anything in opposition to such a praiseworthy spirit. It accords too well with the principle upon which this JOURNAL is and always has been conducted. But when we find preparations in the boxes from persons who have been using the microscope for years, that are utterly worthless either from careless preparation or absence of a few easily written words of explanation, it seems time there should be a change. Too often such preparations are contributed from among discarded slides that are not deemed good enough to be kept in private cabinets. Yet the persons who send them out doubtless joined the club for the benefit they hoped to derive from seeing the work of others. They contribute worthless stuff, expecting to receive in return good mounts for examination. So much inferior material has been contributed in this way that the boxes are not what they should be. We hope to see early improvement in this respect. If one cannot mount well, he can at least select an object of interest and describe it with care; and the mount may be made free from dirt even by a novice.

There is one other matter that should not need correction, for it is one which each member of the club should feel under obligation to avoid. We refer to the habit some persons have of keeping boxes more than the time allowed by the rules. It is an injustice to the whole club when any member does this; and an offence so utterly without justification that it should not be tolerated by the management of the club. We remember a few years ago the working of the club was much interfered with by the difficulty of getting boxes through certain circuits, and some circuits had to be reorganized, leaving out one or more members, after which there was a considerable improvement. This was true of one of the circuits in New-York city. We hear complaints again arising but it is to be hoped these few words will have an influence for good upon the members who are at fault in the matter.

—o—

POSTAL CLUB BOXES.—Box H<sup>2</sup> contains some excellent preparations:

1. Fossil Oyster Shell Bored by Sponge. J. D. Hyatt. This slide illustrates a subject to which Mr. Hyatt has given much attention. The boring sponge is known to attack oyster shells and to riddle them with holes, but the method by which they are able to penetrate the shells is still obscure. Mr. Hyatt has studied the process with care, and has published an article\* giving his results.

2. Parasites of Canary. Rev. W. Huckel. Mounted in glycerin without pressure, hence they give one a good idea of the living parasites, which flattened specimens cannot do.

3. A section of *Chalina Oculata*. G. I. Whitehead. The preparer might have told us, at least, what *Chalina oculata* is. It is one of the fibrous sponges, having the fibres filled with acerate spicules. The preparation is a good one.

4. Section of Brecciated Jasper. W. H. Mead. A good section; very fine with polariscope.

5. *Stigmaria* from Coal Beds. M. M. LeBrun. A fine, large section, with good description.

6. Portion of Leaf of *Galium aparim*. J. L. Wall. A good preparation, showing well the epidermal cells, hairs, and stomata.

Box D reached us on the 16th of May. It contains some good slides:

1. Human Blood. A. T. Veeder. As a member has written in the letter package, the slide is not properly described, as the account of the method of preparation is so vague that one can scarcely understand what special features are to be noted. The mounting, however, is good.

2. Section of *Trifolium arvense*, with adhering *Cuscuta epithymum*. F. T. Aschman. This is an instructive preparation showing how the parasitic plant derives its nourishment from the clover.

3. Blood Discs of *Menopoma Allegheniensis*. T. D. Biscoe. The species is one of the salamanders. The blood cells are much shrunken, and it appears that the mount was not perfect when it was sent out on its travels.

4. Branched Hairs of the Mullein. E. W. Morley. A fine object. Mr. Vorce suggests to make such mounts thinner by macerating the leaf and stripping off the epidermis, and then to mount for the lieberkuhn.

5. Transverse section of Leaf-stalk of Fern. E. L. Cheeseman. Double stained. Very good, but the section is rather thick.

6. Statoblasts or Winter Eggs of *Plumatella*. W. W. Munson. This slide, which is an interesting one, has suffered from bad usage, but has been repaired on the way.

—o—

A NEW JOURNAL.—A quarterly microscopical journal which promises to occupy a high position among scientific publications has recently been established in Göttingen under the control of Dr. Wilh. Jul. Behrens, assisted by Profs. L. Dippel, Max Flesch, and Arth. Weichmann. It is named the *Zeitschrift für wis-*

\*This journal, Vol. iii, p. 8.



*senschaftliche Mikroskopie.* Two numbers have been received at this office, and they are full of very valuable information, both in the form of original articles and in information relative to special subjects collated from various sources.

Germany seems to be the great centre of strictly scientific research with the microscope. This we may say without disparagement of the meritorious work that has been done and is in progress in this country and elsewhere. The opportunities for work here are not the same; and consequently the number of workers is much smaller. It is with regret we are obliged to confess that there is no demand in this country for a thoroughly scientific publication devoted to microscopy. On the contrary, there are those who have complained that even this unpretentious JOURNAL was 'too scientific' for their tastes and wants.

Such persons should look over the pages of the *Zeitschrift* and learn what a vast difference there must be in the requirements of German and American microscopists. Possibly they would then see that we are far behind Germany in our appreciation of scientific microscopy.

It is not, nor has it been, our desire to make this JOURNAL of a heavy, scientific character, believing that there is not only a larger demand for a publication such as it is, but also that its good influence will be more widely felt than if it were less popular in tone. Our aim has been to publish a popular journal, giving correct information, keeping abreast of the times, and one that should have a practical value to workers with the microscope. Those who are engaged in research must take foreign journals. It is enough for us if this paper affords sufficient encouragement to research to make the others valued; and perhaps its influence will lead to a demand for something more advanced in this country. Much excellent microscopical work is in progress here,

and we may hope for an American journal at some future time that shall be an exponent of American investigations in biology, histology, and microscopy generally.

Only two numbers of the *Zeitschrift* have been issued, but it is already one of our most valued exchanges.

—O—

**ELECTRIC LIGHT FOR MICROSCOPY.**—The electric light bids fair to become the light of the future, as it is already superseding all other artificial lights in large cities. No one can foresee the great possibilities in the production of electricity on a small scale for economic purposes, but already there are indications that promise well for a method, eventually to be perfected, which will enable electricity for illuminating purposes to be produced without trouble and economically in private residences. Doubtless the problem of electric illumination for single families will soon be fully solved, when the demand for electric lights suitable for microscopical work will arise.

Two important articles upon the use of the electric light in microscopy have just been published in the second part of the *Zeitschrift für Wiss. Mikroskopie*. The first is by Dr. Theodor Stein, entitled 'The Use of the Electric Incandescent Light for Microscopical Investigations and Microphotographic Purposes.' The title fully expresses the scope of the article, which is illustrated with seven figures. The arrangement of a microscope with incandescent lamps requiring two or three Bunsen cells of 20 cm. height to produce the light is described. There are two small lamps, one with a globe of about  $\frac{3}{8}$  of an inch in diameter, attached to the mirror-bar in place of the mirror; the other about an inch in diameter, attached to a jointed arm fixed to the body of the microscope for use above the stage. The wires are so arranged that the current can be instantly passed from one lamp to the other.

A rheostat is also provided to regulate the strength of the current. The apparatus is very complete and well devised.

Besides the illuminating apparatus, the stage is provided with a spiral of platinum wire through which a current may be passed to heat the air which passes up through the opening in the stage. In this way the slide and specimen under examination are heated to any desired temperature. A method of measuring the temperature of the object is also described.

The arrangement for photomicrography with two battery cells is very attractive, as it seems so exceedingly simple and convenient. The lamp may be attached to the stand in place of the mirror, or it may have an independent support with joints permitting of proper adjustment. In practice it seems to be eminently successful up to magnifications of 200 diameters, but the exposures for such a power require to be rather long—about ten minutes or more.

For microscopical work in summer the electric light possesses great advantages, and when it is considered that a couple of Bunsen cells will suffice to give the necessary current, it would seem well worth while for dealers in microscopes to provide the apparatus, so that one need not await the developments so confidently anticipated in electric lighting. The expense cannot be very great, and to be able to work without suffering from the proximity of a lamp, which is like a furnace in midsummer, would be a great boon to all who use the microscope.

The second article to which we have referred is by Dr. Max Flesch. It treats of the value of the electric light for microscopical use, but further reference to it must be deferred until next month.

—O—

DESMIDS OF THE UNITED STATES.—Our reference to Mr. Wolle's work on the desmids of the United States was written before a copy of the book

had reached us. Having since received a copy and given it a careful examination, we can only say that it far exceeds our expectations. The illustrations especially are exceedingly good and remarkably true to nature as regards color. Our examination has not been so critical as to reveal errors in the text, if such there be—and it is scarcely possible that the book is perfect—but we can safely say that the work has been very carefully done.

We understand that only a small edition has been printed, and that the demand for copies has already been unexpectedly large. To be sure, the edition is not exhausted yet, but we would not advise much delay in sending orders. The book is really sold very cheap, and the price should be raised after a short time.

—O—

PREPARING ANTHERS.—The ordinary method of preparing the cells of anthers for examination is long and quite unsatisfactory. It consists in macerating the anthers in water, long and careful rubbing or trituration, and thus obtaining some shreds of the tissue showing the fibrous cells forming their walls. Mr. J. Ratabone has described\* a simpler method. The anthers are placed in alcohol of  $\frac{9.5}{100}$  per cent. for about five minutes, triturating *grosso modo*, and then in distilled water. In this way the cells open as by enchantment, the pollen-grains are easily detached, and air-bubbles give no trouble. They are preserved in glycerin.

—O—

SCHRÖDER'S CAMERA LUCIDA.—The new camera lucida which was so highly commended in these columns some time ago is now, as we learn from an advertisement in *Science Gossip*, offered for sale at 45s. (about \$10.50) by Messrs. Ross & Co., of London. We give this information for the benefit of numerous subscribers who have made inquiries

\* Soc. Belge de Micr., *Bull. des Séances*, vii, cxli.



concerning it, but to whom we have not heretofore been able to state the price, or even to say whether the instrument could be obtained at all. We are confident that whoever purchases one of them will find it all we have declared it to be.

Our readers will recall the construction of this instrument from the description already given. It consists of two prisms, with their contiguous surfaces separated by a thin film of air, made on the principle first devised by Mr. Wenham, and applied by him to the construction of a binocular prism for high powers of the microscope. The adjustment in manufacture is quite difficult, we are informed; and it may be inferred that it is so from the fact that the binoculars, although pronounced to be excellent, have not been manufactured in any considerable number.

The special point of superiority in this instrument, which we observed when we had the privilege of trying the first one ground and fitted in an unfinished mounting, is the clear view of the pencil and paper with good light on the object. It is a difficult matter to decide fully upon the merits of a new instrument from a single trial, but what we were able to see at that time led us to form a very high estimate of the value of this instrument.

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### NOTES.

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—Mr. T. Bolton's February Portfolio of Drawings has come to hand, and is of much interest. As the portfolio is issued to persons who are able to receive living specimens from Mr. Bolton they are to them of special value, but they are also useful to microscopists in this country who are studying pond life. There are sixteen plates in this number, with descriptions, which are sold for one shilling, and the figures are quite good enough to assist in recognizing the organisms found. Mr. Bolton's address is Birmingham, England.

—*Drugs and Medicines of North America* is the title of a quarterly magazine devoted to the historical and scientific dis-

cussion of the botany, pharmacy, and therapeutics of the medicinal plants of North America. The first number came to hand last month. From the prospectus we learn that the projectors of the work intend to make it a valuable 'compendium that shall represent exhaustively all known researches in this important field,' and with this end in view they have got together a very full library and a complete herbarium. Illustrations will be numerous, and microscopic structure will be adequately shown. Such a publication will undoubtedly meet with ready support from both physicians and pharmacists. The publishers are J. W. & G. C. Lloyd, Cincinnati.

—The *Frankfurter Zeitung* states that Dr. Reinsch has found, as the result of a series of investigations, that the surfaces of 50-pfennig pieces (sixpences), which have been long in circulation, are the home and feeding ground of a minute kind of bacteria and vegetable fungus. An extended series of observations showed that this is the case with the small coins of all nations, the thin incrustation of organic matter deposited upon their surfaces in the course of long circulation rendering them very suitable for this parasitical settlement. Dr. Reinsch scraped off some of these incrustations, and with a small scalpel divided them into fragments, which were subsequently dissolved in distilled water. The employment of lenses of high power showed the bacteria and fungi distinctly.

—The following announcement has been published by Mr. E. H. Griffith, of Fairport, N. Y., which promises to be a very practical and useful undertaking:—

'At the Annual Meeting of the American Society of Microscopists, to be held in Rochester, N. Y., commencing August 19th, 1884, one entire session is to be devoted to practical illustration of the methods of work by experienced microscopists. Tables will be arranged in a room or rooms provided for the occasion, which will be occupied by experts in microscopical work. How to measure the angle of aperture of objectives, how to measure the magnifying power of objectives and oculars, and other work of similar character will be shown. How to count blood corpuscles and to measure them will be illustrated. How to collect and to preserve material for future mounts, how to make cements, reagents, etc., will be explained. Microscopists will cut vegetable and animal sections and stain them; prepare insects, hairs, scales of butterflies, blood, urinary

deposits, crystals, pathological specimens, mineral sections, diatoms, etc., etc., for mounting, and will show how to mount dry and in different media. Several in the same line of work may show their individual methods at the same time.'

This seems to be one of the best schemes yet devised for popularizing the use of the microscope, and we trust the members of the society will support the effort well.

—We are authorized to state that the Rev. W. H. Dallinger, of England, is expected to be present at the meeting of the American Society of Microscopists, at Rochester.

—It is stated that Bellevue Hospital Medical College is to have a laboratory especially designed for microscopical investigations, through the liberality of Mr. Andrew Carnegie, of Pittsburg, who has given the college the sum of \$50,000 to be expended in the erection of a new building and the purchase of apparatus.

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## CORRESPONDENCE.

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### Mounting. Catching Insects.

TO THE EDITOR:—Your articles and hints about mounting in the JOURNAL are invaluable to me, though I do not get time to use them all, as I can only work about one evening a week. Have mounted some good slides of foraminifera from sand shaken from Mediterranean sponges at a drug store. Was very successful in killing hydra last night by the hot-water method, but did not get far enough to mount any. I shall try it in a few days. A mounting needle bent like a hook at the end, dipped in alcohol, is the best way I have found for capturing small insects on windows, under stones and boards. Have used it for years, and the insect always is drawn into the drop included in the hook. Dipping the needle into the alcohol frees the insect from the drop and loads the needle again, and the capturing goes on easily, surely, and rapidly. Even the evanescent spring-tails can be taken in this way.

[The above method of catching insects, first described on page 59, deserves to be remembered. We would suggest that, owing to the hardening and stiffening effect of alcohol, it might be better to dip the needle into concentrated carbolic acid to free the insects. In carbolic acid they do not draw up their limbs as in alcohol,

and after a few moments in the acid they are ready to be mounted in balsam or in any other medium.—ED.]

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### Resolution of Amphipleura.

TO THE EDITOR:—Having experimented occasionally during the last two months on *A. pellucida*, I find that this diatom is well resolved without the use of a mirror or other illuminating apparatus, by direct sunlight above the stage. The microscope should be so placed that the light may fall on the circumference of the stratum of immersion fluid, obliquely to the upper surface of the slide, and care should be taken to have one end of the frustule point towards the sun. As the discovery of this method of illumination was merely accidental, it has occurred to me that it may have some bearing on the resolution of *A. pellucida* by central light. Take for example the experiment of Prof. Forbes (this JOURNAL, June, 1883, page 118) where it is noted that 'while the resolution is perfect when the diatom lies transverse to the stage, they disappear as the direction is changed.' As the Professor suggests, this would not have occurred if the resolution had been effected by central light. It seems highly probable that in Prof. Forbes's case, as in mine, the microscopes were accidentally placed in such a position that the direct sunlight above the stage resolved the diatoms.

My objective is a  $\frac{1}{10}$  of 110° B. A., by H. R. Spencer & Co. It resolves Dr. Sloan's *A. pellucida* in balsam (this JOURNAL, Oct., 1883, page 198) by lamp-light and concave mirror, both above and below the stage, and by direct sunlight above the stage. The resolution is better with the light above than below the stage. Possibly the immersion fluid acts in some way as a condenser.

F. H. GOWEN.

WEST NEWBURY, Mass.

March 20th, 1884.

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### Resolution by Central Light.

TO THE EDITOR:—I recently sent you a note in which I stated that *A. pellucida* is easily resolved by direct light above the stage, and suggested that this might be a possible explanation of the resolution of this diatom by 'central light.' I have since succeeded in resolving *A. pellucida* in balsam by sunlight, with the mirror in a strictly central position; but on investigating the course of the illuminating rays I found that the resolution was effected by light reflected within the slide, from one



of its convex edges; and that, instead of being central, the light was very oblique. I have not tried this illumination with lamp-light, but think it would succeed, provided the edge of the slide have the right curve. I send a diagram which will, I think, illustrate the manner in which the light is reflected.

Possibly a prism might be made to connect by immersion contact with the lower surface of the slide, close to one side of the hole in the stage, which would condense the light and reflect it very obliquely with the mirror central.

F. H. GOWEN.

WEST NEWBURY, Mass.

April 28th, 1884.

[The diagram shows a ray of light passing from the left-hand edge of the mirror to the right-hand edge of the slide—the latter being represented in section at right angles to its length—and from thence reflected upon the object.—ED.]

#### Clearing Fluid,

TO THE EDITOR:—I find in practice that about equal parts of Squibbs' absolute alcohol and eucalyptus oil forms a very good clearing fluid for animal or vegetable tissues. When the tissues are freshly cut I place them in commercial alcohol for a few minutes. I next transfer them to the clearing fluid, as above described, for a period of about ten minutes. They are next placed in pure eucalyptus oil, which removes the alcohol; a few minutes' immersion will suffice. When they are ready to be mounted in balsam I sometimes add a few drops of pure carbolic acid to the clearing fluid, but the latter may be dispensed with. I have made a number of very clear mounts in this way.

It is not well to keep tissues longer than necessary in the fluid. Vegetable tissues become hardened and brittle when kept several days in the clearing fluid.

THOMAS TAYLOR, M. D.

#### Questions about Mounting.

TO THE EDITOR:—Several of the fine diatom slides I have, by Möller, are having the covers cracked; I suppose it is caused by shrinking of balsam. Would it be a good idea to run a Bell's cement ring around them; they are not cemented at all? My experience of white zinc cement agrees with yours.

In speaking of Box R in the March number, of No. 2 you say 'this one has a bubble in it, but that may have been pur-

posely left.' Where does the purpose come in? I never had the slightest difficulty in enclosing bubbles, and shall hereafter consider all bubbles in my mounts left on purpose.

[The above is a portion of a letter not sent for publication, but it affords an opportunity to answer some questions that are not unlikely to arise from time to time.

The balsam slides had best be fixed by rings of benzole or chloroform balsam or damar. Bell's cement will do, but we think a balsam or damar finish is neater.

Bubbles are occasionally left in fluid mounts, especially when the cells are deep, under the impression that the air they contain, being very elastic, prevents injury to the cell from internal pressure when the temperature rises. We confess to grave doubts if such bubbles are of any benefit whatever.—ED.]

#### The Congress Nose-piece.

TO THE EDITOR:—The enclosed affidavit is a sufficient answer to Prof. McCalla's letter, and as he has made so many erroneous statements I beg leave to doubt anything further from him; and more especially after seeing a copy of his so-called drawings in the April number of your journal, which I believe to have been executed since he received a sample of my nose-piece. In proof of my assertion I would say that when Prof. McCalla first spoke to me last August he then referred to two pins or catches. I said then that three were much better, as there was not so much danger of sagging to one side with three as with two. In further proof that he referred to two pins I will quote these few words from a letter written to me by Mr. E. Pennock: 'Remember that in a general way that it was a sort of bayonet-catch arrangement, and he [Prof. McCalla] thought that it would require careful workmanship to make it grasp both sides at once.' When Dr. Mohr was in my shop I showed him drawings that I have in my note-book, and which are dated September 1st, 1883. If Dr. Mohr is the person referred to as having been shown the drawings I am sure he would not willingly assert that I even so much as intimated that they were made by Prof. McCalla. I would have you know that the drawings I have in my note-book are those that I made myself; but what the Professor means by stating in one sentence that he made them and in the following sentence saying that he does not

assert he made them, is more than I can understand.

I want to see a sworn copy of the drawings or sketches made previous to August, 1883, and also the oaths of two credible witnesses who saw them previous to August, 1883. I want no thinking such is the drawing, but proof.

As I have several samples of adapters very much like the one which Prof. McCalla shows in fig. 13, page 66, I will freely give one to any person who is interested and will send for it, for they are much more trouble to insert in the instrument than objectives with the society screw, for the reason there is no guide to find the entrance or position of the slots, in the improvement of which lies one of the chief points of my nose-piece.

If Prof. McCalla had perfected his idea and fully demonstrated that his invention was a success, is it not reasonable to expect he would have brought his drawings and description to the Chicago meeting, more especially as he intended to make special reference to such a device? But now, after sleeping over his crude idea for three years, and waiting until some other person puts it into practical shape, he has found ample time to make drawings and to write a description of it.

WALTER H. BULLOCH.

[Mr. Bulloch encloses with the above communication a sworn statement, declaring that 'Prof. McCalla never showed any drawings or sketches in my presence at Detroit or any other place, and that he never mentioned the subject in my hearing, excepting as given in my letter in the March number,' etc.]

We trust this unfortunate controversy will be speedily brought to a close, but having gone thus far we cannot in justice to either party bring it to an abrupt end here. We think, however, that Mr. Bulloch has stated his case at length, and unless new developments render it necessary, as a matter of justice, that more should be added by him, Prof. McCalla's reply, if he chooses to make one, should end the controversy, which we vainly endeavored to prevent when its first mutterings were heard. It is but right for us to state, however, that Prof. McCalla sent us his first drawings for publication on the 28th of January, and in a letter of that date he wrote as follows: 'I can and do solemnly affirm that they are exact copies (except as to enlargement of scale) of my original drawings made in July, 1880, drawn with more care and accuracy, but not changed in any way.'—ED.]

## NOTICES OF BOOKS.

*Sexual Neurasthenia.* [Nervous exhaustion.] Its hygiene, causes, symptoms, and treatment, with a chapter on diet for the nervous, by George M. Beard, A. M., M. D., formerly Lecturer on Nervous Diseases in the University of the City of New-York; Fellow of the New-York Academy of Medicine; Member of the American Medical Association; Author of 'Our Home Physician,' 'Hay Fever,' 'Stimulants and Narcotics,' one of the Authors of 'Medical and Surgical Electricity,' etc. [Posthumous manuscript.] Edited by A. D. Rockwell, A. M., M. D., Fellow of the New-York Academy of Medicine; of the American Neurological Society, and Electro-Therapeutist to the N. Y. State Woman's Hospital. One of the Authors of 'Medical and Surgical Electricity,' etc. New-York: E. B. Treat. 757 Broadway. 1884. (8vo, pp. 270. Price \$2.00.)

'The philosophy of this work is based on the theory that there is a special and very important and very frequent clinical variety of neurasthenia (nervous exhaustion) to which the term sexual neurasthenia may properly be applied. While this variety may be and often is involved as cause or effect or coincident with other varieties—exhaustion of the brain, of the spine, of the stomach and digestive system—yet in its full development it can be and should be differentiated from hysteria, simple hypochondria, insanity, and various organic diseases of the nervous system, with all of which it had until lately been confounded.'

## Exchanges.

Exchanges are inserted in this column without charge, [They will be strictly limited to mounted objects, and material for mounting.]

Wanted—Diatoms on seaweeds and in muds, from all the tropic seas. Offered a large quantity of fine selected diatoms and other slides, or cash.

J. C. RINNBOCK,  
14 Simmering, Wien, Austria.

Will exchange well mounted slides for others well mounted.

H. H. PEASE,  
1271 Broadway, N. Y.

Living red *Astasia namatodes* (*Euglena viridis*) and *Volvox* sent on application, or mounts of the same in exchange for algæ, fungi, or infusoria.

J. M. ADAMS,  
Watertown, N. Y.

Will exchange various mounts of crystals for other slides, and material for mounting.

JAMES E. WHITNEY,  
Rochester, N. Y.



# THE AMERICAN MONTHLY MICROSCOPICAL JOURNAL

VOL. V.

WASHINGTON, D. C., JULY, 1884.

No. 7.

## Notices of New Fresh-water Infusoria.

BY DR. A. C. STOKES.

*Hymenostoma*, gen. nov. (Greek, *hymen*, a membrane; *stoma*, a mouth).

Animalcules free-swimming, ovate, more or less depressed, entirely ciliate, a fascicle of several diverse, flexible setose cilia projecting posteriorly; adoral groove large, ventrally disposed, somewhat on the right-hand side of the median line, bearing on its left-hand margin a row of vibratile cilia, and on its right-hand border a voluntarily vibratile membrane; oral aperture ovate, situated at the posterior and deepest part of the adoral depression, and bearing an extensile and retractile membrane on its anterior and left-hand margins; contractile vesicle double; nucleus posteriorly located; anal aperture postero-terminal.

*Hymenostoma hymenophora*, n. sp.

Body ovate, depressed, persistent in form, the length about twice the width, striate longitudinally and entirely ciliate; dorsal surface convex, the ventral flattened, somewhat concave; the posterior extremity rounded, the anterior slightly emarginate; the left-hand border convex, the right-hand margin somewhat flattened; cilia of the cuticular surface fine and short, those on the posterior extremity more conspicuous, the posteriorly projecting, setose fascicle formed of hair-like, flexible cilia of diverse length, two being usually of equal length and distally curved, the whole commonly directed obliquely

toward the left; adoral depression large, obovate, longitudinally disposed, widest anteriorly and extending backwards and inwards for a distance equalling about six-sevenths of the entire length of the body; oral aperture large, ovate, placed on the right-hand side of the median line of the adoral depression, the extensile and retractile membrane which partly surrounds it thrown into folds on its left-hand margin; adoral cilia fine, dense, extending across the adoral depression and ordinarily visible only after the infusorian's death; the membrane attached to the right-hand border of the adoral groove voluntarily vibratile, projecting from the anterior extremity as a short, conical, hood-like extension, one side of this projection inserted on the anterior left-hand margin of the adoral depression, the other side continued as a conspicuous, lamellate membrane for about one half the length of the adoral groove, when it is abruptly narrowed and thence descends into the depression, is continued to its posterior extremity and apparently extended to surround the oral aperture; nucleus elongate, band-like, curved, posteriorly located near the right-hand border; contractile vesicle double, diverse in size, one very small and situated near the dorsal surface and sub-central to the right-hand margin, pulsating quickly and almost immediately reappearing through the coalescence of several minute vacuoles; the other large, posteriorly placed somewhat to the left-hand side of the median line, pulsating at long intervals and forming slowly; parenchyma transparent, minutely granu-

late. Length of body,  $\frac{1}{100}$  inch. Habitat, the surface of decaying leaves at the bottom of shallow pools.

This infusorian resembles *Lembadion* and will probably follow it in a scheme of classification. The movements of both are also similar. When first placed on the microscope slide they swim backwards by rapid revolutions on their long axes, the motion probably being caused by the vibrations of the adoral membrane. When quietly searching for food they swim evenly forward or in irregular circles. *Hymenostoma* differs from *Lembadion* in the posterior, ventral position of the mouth, the greater length of the adoral cilia, the abruptly narrowing membrane, the double contractile vesicle, and the greater number and sinistrally directed setæ of the posterior extremity, four being the usual complement with *Hymenostoma*.

In its food-habits *Hymenostoma* is omnivorous, taking diatoms and animalcules of comparatively enormous size, often leaping from side to side as if eager to seize its prey. The food particle is often somewhat larger than the oral aperture, so that the entrance becomes blocked and the captive not at once engulfed. Just how this engulfing process is performed I have not learned. Neither the adoral cilia nor the oral membrane seem to take active parts. The cilia on the left-hand margin of this depression are seen to be very fine and dense when the animalcule has been killed, having, after death by iodine, the property of falling from their attachment as a continuous fringe. At other times they are rarely visible, on account of their rapid vibrations. The mouth is also often very inconspicuous until the surrounding membrane is extended and vibrated. The food, after passing this opening, invariably takes a position in the left side of the body.

The rate of pulsation of the smaller contractile vesicle is not constant. When the infusorian is multiplying

by transverse fission the contractions are at the rate of twenty-eight per minute; at other times the movement is as snapping, but at longer intervals.

The infusorian is represented in figure 1, magnified 600 diameters.

*Trachelophyllum vestitum*, sp. nov.

Body elongate flask-shaped, much flattened, very extensible and elastic, the length from four to five times the breadth; neck somewhat fusiform, about one-half of the body in length, the apical constriction truncate, somewhat dilated distally; the entire surface, except the apical constriction, invested by a mucilaginous, structureless or finely granular coating whose depth equals about one-third the entire length of the cuticular cilia, the latter being fine, thinly clothing the body in longitudinal rows, their action somewhat independent and irregular, only that portion of each cilium vibrating which extends beyond the mucilaginous investment; pharyngeal tract distinct, finely striate longitudinally; nuclei two, ovate, one nodule located in the anterior, the other in the posterior body half; contractile vesicle single, posteriorly placed, quickly forming after systole by the union of several vacuoles which often become visible just previous to the pulsation; anal aperture postero-terminal; trichocysts (?) abundant, acicular, scattered and collected in fascicles. Length of body  $\frac{1}{100}$  inch. Habitat.—The surface of submerged and water-soaked objects at the bottom of shallow ponds.

The body contains needle-shaped objects scattered throughout its substance and collected in obliquely-disposed bundles, deeper, apparently, than the cortical layer. They may be trichocysts, but their form and the action of the light suggest that they may be crystals. They closely resemble the acicular raphides so abundant in *Lemna*, *Tradescantia*, and other common plants. The solution of tannic acid in glycerin has no visible effect upon their position. Figure 2





new pharynx was produced, and the hardy little infusorian extended its shortened body and hurried off in the same hasty way as if nothing unusual had happened.

In its contour it resembles *T. pusillum*, C. & L., differing chiefly in the larger size, being from three to four times greater, and in the more spherical form of the nuclei. It is shown extended in figure 3, magnified 170 diameters.

*Litonotus pleurosigma*, sp. nov.

Body linear-lanceolate, elongate, flattened, somewhat sigmoid when viewed ventrally, flexible and elastic, length five or six times the breadth, widest centrally, and tapering to each extremity; dorsal surface convex and naked, the ventral flat, ciliated, longitudinally striated; neck-like portion equalling about one-fourth of the length of the entire body, its extremity curved toward the right; tail-like posterior extremity short, obtusely pointed, somewhat curved toward the left; oral aperture subterminal, very dilatable; oral cilia not conspicuously larger than the ventral; trichocysts few, long, scattered throughout the body; nuclei two, ovate, subcentral, connected by a funiculus; contractile vesicles small, numerous, the greater number arranged in a line along the left-hand border, three or four dispersed along the right-hand margin; parenchyma of the body coarsely, of the neck and tail-like portions, finely granular; anal aperture postero-terminal. Length of body  $\frac{1}{160}$  to  $\frac{1}{100}$  inch. Habitat.—The surface of dead leaves and twigs at the bottom of shallow pools.

In form this animalcule resembles *Litonotus fasciola* (Ehr.) S. K., differing from it and from all other species of the genus, in the multiple contractile vesicles. It is somewhat difficult to determine the exact number of these vacuoles. Usually twelve can be counted, nine in a row along the left-hand border and four on the right, but as they come and go in ir-

regular order the observer has quite a task to count and omit none, the infusorian being at the same time in motion.

The position of the oral aperture is also characteristic. In the diagnosis of the genus this orifice is stated to be situated at the base of the neck-like prolongation. With this species, however, the writer has seen large food masses enter through an opening that is almost apical, and remarkably elastic. On account of this sub-terminal position it may hereafter be advisable to relegate the infusorian to a new genus.

Conjugation of two individuals has been repeatedly observed. Union takes place between the anterior one-half or two-thirds of the ventro-lateral borders, but how long it continues I have been unable to determine, as none have become united during my observations, all those noticed having joined themselves previous to capture, or being only on the point of separating when first seen. Changes in the neuclei were in each instance sought for, but nothing unusual appeared.

Multiplication is by transverse fission, which, it is presumed, succeeds conjugation. The posteriorly separating moiety possesses the caudal prolongation of the mature zooid, the freshly-divided surfaces being usually evenly rounded. Within half an hour, however, after complete separation, the neck-like portion is developed on the one, and the tail-like prolongation on the other, so that each infusorian then differs from the mature animalcule in size chiefly, but, at times, in the smaller perceptible number of pulsating vacuoles. Immediately after fission each part bears a remarkable likeness to *Litonotus varsaviensis* Wrz.

In figure 4 is shown the lateral aspect, in figure 5 the ventral, and in figure 6 two zooids in conjugation.

*Litonotus helus*, sp. nov. (Greek, *helos*, a nail-head).

Body elongate-lanceolate, exten-



sile, flexible and contractile, five to six times as long as broad, widest centrally, thence gradually narrowing to the origin of the anterior neck-like prolongation which is not conspicuously distinguished from the body, and to the posterior extremity; somewhat gibbous and bearing on the right-hand margin a series of about eight equi-distant, hemispherical elevations, each of which contains several trichocysts; dorsal surface smooth and naked, the ventral ciliated and longitudinally furrowed; neck-like prolongation equalling about one-third the length of the entire body, its extremity curved toward the right; tail-like portion short, flat, obtusely pointed; food particles and endoplasmic granules not scattered throughout the neck, tail or lateral borders of the body; trichocysts very numerous, obliquely set along the left-hand border of the neck and body, continued around the margin of the tail-like region, and contained within the boss-like elevations of the right-hand border; contractile vesicle single, posteriorly placed near the dorsal surface, in advance of the tail-like prolongation, and formed by the coalescence of several small vacuoles; nuclei two, ovate, sub-centrally located. Length of extended body,  $\frac{1}{10}$  inch. Habitat.—Standing water.

The oral aperture has not been observed. Careful examination has discovered no vacant spot between the multitudinous trichocysts which might be occupied by that orifice; the inference may therefore be that the mouth is subterminal, as with the preceding species.

The infusorian is capable of contraction to about one-third of its extended length, when it presents an irregularly ovate aspect, the right-hand border being coarsely crenated by the approximation of the hemispherical protuberances. Figure 8 shows it ventrally in optical section, extended and magnified 300 diameters.

*Petalomonas disomata*, sp. nov. (Greek, *disomatos*, double bodied.)

Body ovate, more or less pyriform, depressed, widest and rounded posteriorly, the anterior extremity obtusely pointed, both the dorsal and ventral surfaces having a longitudinal groove or channel extending in or near the median line from the apex to the posterior extremity; oral aperture conspicuous; flagellum somewhat longer than the body, arising from a point on the ventral surface a short distance back of the anterior apex, directed rigidly in advance, the distal extremity only vibrating; contractile vesicle single, in the anterior body half near the median groove; nucleus on the opposite side somewhat further back; parenchyma transparent anteriorly, granular, and semi-opaque with food particles posteriorly. Length of body  $\frac{1}{1000}$  inch. Habitat.—The surface of decaying leaves at the bottom of shallow ponds.

The movements of the animalcule are directly forward in a straight line, with sudden changes to the opposite direction, the flagellum being frequently held in contact with the slide or other object traversed, and the body obliquely elevated, the oral aperture thus apparently gliding over the ground in search of food, which consists chiefly of minute refractive particles, seemingly small starch granules. Occasionally the hind body has a green tinge by the inception, apparently, of chlorophyll grains; usually, however, the animalcule is colorless.

At times the dorsal and ventral channels are indistinct, being represented by only a slight indication of a depression; in other individuals the sulci are deep and disposed slightly on one side of the median line, thus dividing the body unequally.

In figure 7 is shown the infusorian in ventral aspect, magnified 1,000 diameters; in figure 9 a transverse optical diagrammatic section, exhibiting the double-bodied appearance produced by the two medially disposed channels.

### A New Illuminator.

Some time ago the Bausch & Lomb Optical Company introduced a new form of illuminator for the sub-stage, which is illustrated in fig. 21. We have reserved particular reference to

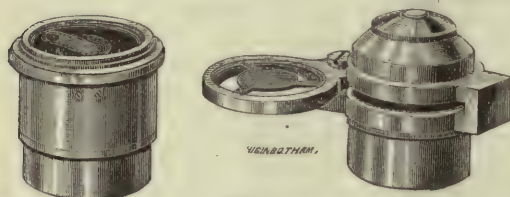


FIG. 21.

this accessory for some time, hoping to be able to prepare an article on the subject of illumination, but as opportunity has not yet offered for writing such an article we figure the instrument in this place, and will take occasion to refer to it again in future.

It will be seen that the condenser is intended for universal use; diaphragms of various forms can be placed in the carrier to give dark-field effects, or oblique light from different azimuths, and in addition there is another diaphragm for oblique light, shown in the left-hand figure.

### Mr. Griffith's Turn-table.

The illustration of the turn-table recently introduced by Mr. E. H. Griffith was inadvertently left out of last month's issue. It is now shown in fig. 22, and no description seems

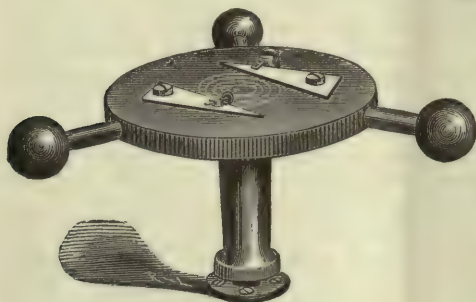


FIG. 22.

necessary in explanation of the cut. We would judge from the appearance of the instrument that it would be efficient, and at the same time inexpensive to purchase.

For ourselves, we like a turn-table that will run for a considerable time without constant urging. For this reason a heavy face-plate is necessary, and Mr. Griffith seems to have carried out the idea by the heavy balls supported from the periphery of the plate. The advantage of good momentum is found principally when it becomes necessary to turn off a ring of hard cement with the point of a knife. A light wheel would not do for such work, which is easily done on some turn-tables.

### A New Design for a Microscope Cabinet.

BY C. E. BEECHER.

A good cabinet bears nearly the same relation to the slides that the cover of a book bears to the contents. A valuable book is worthy of a fine binding. Literary trash merits the yellow cover it usually receives. A fine collection of mounted objects should have a becoming receptacle for its preservation.

Two large cabinets, made after the following design, have been in constant use for three years, and have given such satisfaction that I consider it of sufficient importance to make known their construction. At present there is a great demand for cheap cabinets, but none of them, so far as I know, are very satisfactory for working collections. They are serviceable more for the reception of duplicates or other objects which are not often referred to.

The accompanying figures (Fig. 23) show the principal details of construction, and require little explanation. The double-pointed tacks can be made of brass



wire and driven into the board after making holes with a small awl.

The paste-board discs are cut with a steel punch from board having a thickness of about an eighth of an inch. To produce a neat appearance the board should be covered with a sheet of green or other colored paper

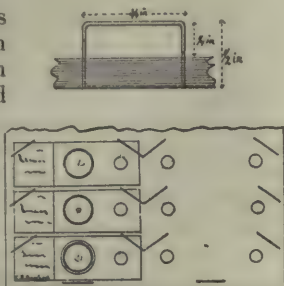


FIG. 23.

before cutting the discs. The trays should be of soft wood about one-fourth inch thick, with a piece across the ends to prevent warping. They may be made of any convenient size. In the placing of the tacks and discs it will be found necessary to use a form in order to insure regularity. The method of removing the slides is by tilting them with the finger.

The advantages claimed for a cabinet constructed on this plan are, briefly, the following: The little lost space and the security each slide has when in place from shucking or rubbing on its lower surface, the facility with which a slide may be removed or replaced, and the ease with which the trays may be cleaned from dust.

ALBANY, N. Y.

### Celloidin for Imbedding.

[Celloidin is a material which promises to be largely used in microscopical work. We have not yet been able to try it, but will do so before long, as it seems well adapted to some work in which we shall soon be engaged. It will be seen from our advertising pages that it can be ob-

tained from the agents, Messrs. Bachrach & Bro., in Baltimore. The two following communications are copied from the *New York Medical Journal*, in which they first appeared.—Ed.]

Celloidin was first introduced into histological technique by Schiefferdecker, (*Arch. f. Anat. u. Phys.*, 1882, pp. 199–203,) and has met with general favor. It is a pure pyroxlin, free from all foreign organic constituents, and makes a clear solution free from sediment. It is soluble in equal volumes of alcohol and ether, and the degree of concentration may be varied to suit any particular case.

The following is the manner of preparing and using the material, as practiced in the laboratory of the Alumni Association of the College of Physicians and Surgeons: A saturated solution of celloidin is made in a mixture of equal parts of ether and alcohol (97 per cent.); this requires about twenty-four hours, with occasional agitation. The specimen to be imbedded is soaked in a mixture of ether and alcohol for some time, then transferred to the imbedding fluid and allowed to remain over night.

One of two ways of imbedding may be adopted:

1. Cover the smooth surface of a cork with a thick layer of celloidin solution and allow it to dry; place the specimen, which had previously been soaked in the imbedding fluid, on this, and cover it, layer by layer, with a solution of celloidin, allowing each layer to partially dry before applying another. When the specimen is completely covered, immerse in alcohol of 80 per cent. for twenty-four hours, when it will be ready to cut.

2. The specimens are imbedded in paper boxes in the usual way, or a cork is wrapped with one or two layers of thick writing paper, allowing it to project an inch or an inch and a half above the surface of the cork. By this procedure a round

box, with the cork for a bottom, is obtained. Into this box pour a small quantity of the imbedding fluid, and allow it to dry. The specimen, having been previously soaked in the celloidin solution, is now placed in the box, adjusted as to position, and allowed to dry for five or ten minutes, so as to fix it; the box is now filled with the imbedding fluid. The boxes are exposed to the air until the imbedding mass has become semi-solid, and are then immersed in weak alcohol (alcohol 95 per cent., two parts, water one part) for twenty-four hours, when the specimen will be ready for cutting. If the specimen has been imbedded in a paper box and sections are to be cut with a sliding microtome, it is necessary to mount it on a cork. This is accomplished in the following manner: Cover the surface of a smooth cork with a thick layer of celloidin solution, allow it to dry, and again cover with the same. Trim off the superfluous imbedding mass from around the specimen, cut the lower surface even, wet it with a drop or two of ether, and adapt it to the layer of celloidin on the cork. Dry for a few moments and place in dilute alcohol for a few hours, when the specimen will be ready for cutting. If the plan of imbedding in the boxes with a cork for the bottom is adopted, the specimen is imbedded and mounted on the cork at the same time.

Sections may be stained with the different staining fluids and mounted in glycerin or other media. If mounted in Canada balsam, and the specimen is to be retained in the imbedding mass, absolute alcohol for dehydrating and oil of cloves for clearing are to be discarded, for they both dissolve the celloidin and alcohol of 96 per cent., and oil of bergamot, oil of sanders, or oil of origanum used.

Celloidin is manufactured by E. Schering, of Berlin, and may be obtained of Bachrach & Brother, Baltimore, Md. It comes in the form of gelatin plates and shreds, put up in ounce packages. The shreds are to

be preferred on account of being more easily dissolved.

G. C. FREEBORN, M. D.

At the laboratory of the New York Hospital the following method is employed in imbedding objects in celloidin: The celloidin, which is a hard, semi-transparent, colorless material, is cut into small pieces and dissolved in a mixture of equal parts of absolute alcohol and ether until the solution is of a thick, creamy consistence. The solution should be kept in a wide-mouthed bottle, closed by a tight-fitting ground-glass stopper. The object to be imbedded is placed in absolute alcohol for two days to remove all the water, then for a day or two in ether, and is then ready for imbedding. The object is then placed in the celloidin, and left there until it is thoroughly soaked through by it. This lasts about four days. When fine sections of delicate tissues—as the lung, spleen, retina, or testicle—are desired, it is better to leave the object in for a week. After removing the object from the celloidin, place it in ordinary alcohol for a short time. The alcohol coagulates the celloidin, and gives the mass the consistence proper for cutting. Absolute alcohol must be avoided, as it dissolves out the celloidin. The object can now be placed on a suitably-sized cork, the surface of which is covered with a few drops of the celloidin solution or an ordinary (thick) solution of gum arabic, and the cork, with object attached, is placed in ordinary alcohol to harden. After hardening, the cork can be fastened in the clamps of a microtome or held in the hand, and the sections cut. The sections can be stained, and mounted in glycerin or in balsam. When mounted in balsam, the sections must be cleared in oil of thyme or bergamot, but not in oil of cloves, as the latter dissolves the celloidin, and renders the mounting of delicate sections almost impossible. The celloidin may be obtained of George Inness.

F. W. MURRAY.



### Fresh Water Algæ.\*

The term algæ signifies sea-weeds, and is used to designate certain marine and fresh-water plants, which, because they bear no flowers, stamens nor pistils, and in fructification produce spores instead of seeds, are styled cryptogamous plants. The algæ comprise not only sea-weeds properly so called, but likewise the gelatinous or scum-like substances found floating on or near the surface of ponds, ditch water, and placid streams; only a very small proportion of the entire class of fresh-water algæ is confined to trunks of trees, shady recesses, or to rocks dripping with moisture.

Owing to the life-like peculiarities exhibited in some stages of their development and growth many of the algæ were believed by Ehrenberg and other microscopists of his time to belong to the animal kingdom, but the wholly vegetable character of the algæ is now too well established to admit of further controversy.

Howsoever great in other respects their individual differences may be, the algæ possess certain characteristics which are common to them all. They are cellular, flowerless, and devoid of roots; their home is in the water; the very few which affect other localities die when deprived of moisture. Their nutriment is absorbed through their entire surface from the medium in which they live. They are totally devoid of vascular tissue; in fact, are mere congeries of simple cells on the arrangement of which depends their structural differences.

As a large majority of them, especially the desmids, are free-floating plants, it would be a waste of time to seek them in rapid waters; they affect pools, sluggish streams and ponds; the latter afford the most satisfactory results to the explorer when the pond is a mile or more in length and is fed by one or two creeks; the indenta-

tions on the margins of such a pond and its tributaries usually abound in water grasses and mosses which shelter and support the floating algæ.

The outfit need not consist of more than a nest of four or five tin cans (tomato or fruit) one within the other for convenience of carriage; ten or a dozen wide-mouthed vials and a small ring-net of fine muslin at the end of a rod about four feet in length. Should a boat be needed it can usually be hired on the spot. After selecting what seems to be a good locality, drag the net a few feet among the grasses and mosses above indicated, allow the bulk of the water to drain through the muslin, and then empty the residue into one of the cans; repeat this process as often as may be desirable. Ten or fifteen minutes after the cans have been filled most of the surface water may be poured off and the remainder transferred to a glass vial, where the solid contents will gradually sink, and the superfluous water can be again poured off and the vessel filled up with deposits from other vials. In shallow places what is known as swamp-moss (*Sphagnum*), bladderwort (*Utricularia*), Water-milfoil (*Myriophyllum*) or other finely-cut leaf water plants are likely to abound; these should be lifted in the hand and the water drained or squeezed from them into a tin can, to be subsequently treated as already stated. A few drops of carbolic acid in each vial, just enough to make its presence perceptible, will preserve the contents for months and even years from deterioration; the green coloring matter (chlorophyll) may fade, but this in the case of the desmids is of little importance; nevertheless, when practicable, always examine the material when fresh. When dried on paper for the herbarium, the specimens can still, after being moistened with water, be microscopically examined, but not with the best results, since the drying is apt to collapse or otherwise distort the cells.

\* Extract from 'Desmids of the United States,' by F. Wolle.

The collector will not know the value of his find until it has been brought drop by drop under the lens of his microscope, and out of the entire mass he may discover nothing to reward his labors; this, however, should not discourage him, as one or two failures are to be expected prior to meeting with an adequate reward. His interest in the study will be greatly enhanced if he keeps a record of it in sketches of what the microscope reveals to him. These sketches should, of course, be very exact, and, in order that they may be so, it is necessary that the microscope should be provided with an eye-piece micrometer with which to measure the length and breadth of the figure to be sketched; a half inch per  $\frac{1}{1000}$  (.001") or  $25\ \mu$  is the most convenient, though  $\frac{1}{4}$  or  $\frac{1}{8}$  of an inch may be a preferable scale for the larger forms. It is so difficult to separate specimens from their accompanying foreign matter that it is seldom amateurs can mount them satisfactorily on slides, and therefore this method of preserving specimens is not open to recommendation.

Although in the microscopic study of the fresh-water algæ much has been done within the past few years, much more remains to be accomplished. The field, instead of growing smaller, seems to widen out with every fresh discovery; localities thought to have been exhausted of additional possibilities have, in subsequent seasons, yielded ample returns to the patient explorer; and if the old territory is not sufficiently attractive there are vast regions into which no student has yet penetrated, where, doubtless, the harvest awaiting the reaper dwarfs all that has been heretofore garnered.

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### Fish Killed by *Utricularia*.

[The following communication from Mr. R. E. Earll, of the United States Fish Commission, will prove interesting to all who have aquaria in

which small fishes are kept. We are surprised to learn, however, that the facts mentioned have been so recently observed. We are under the impression that the habits of the plant have long been known, although unable at present to find any account of its killing of young fishes. Perhaps some botanist among our readers will be able to refer to other observations of a similar nature.—ED.]

Prof. Baird has just received from Prof. H. N. Moseley, of Oxford University, England, a specimen of an aquatic plant holding in its fond embrace a considerable number of young fish which it had caught and killed.

The plant is the well-known bladderwort, *Utricularia vulgaris* L., which is widely distributed over England, and has been introduced into our waters, where it is often found in abundance in ponds and ditches, and in the shoal-water coves along some of our river-banks. It is a large plant, with stems often attaining a length of two or three feet. It has no roots, but floats free in the water, its root-like branches covered with pinnatifid capillary leaves, each bearing one or more small transparent, hollow bladders, with openings at one end, which serve as traps to catch newly-hatched fishes, minute crustaceans, worms, and infusoria. It has no digestive apparatus, but is thought to derive nutriment by absorption from the decomposing animals.

The bladderwort has long been known to catch the lower forms of animal life, but it was only recently that its fish-catching propensities were discovered. Mr. G. E. Simms, of Oxford, was the first to call public attention to the fact on finding that a specimen which had been placed in his aquarium was actually catching and killing large numbers of newly-hatched perch and roach which had hatched from a mass of eggs lying at the bottom. The little fishes were usually caught by the head, but some were caught by the tail, while others were doubly trapped, the head being



held fast by one trap and the tail grasped by another.

To learn something of its destructive powers, Mr. Simms placed 150 perch fry in a glass vessel containing specimens of *Utricularia*, and at the end of two days all but one or two had been trapped.

Prof. Baird thinks the discovery has an important bearing on the future abundance of several important food fishes in our country. Twelve to fifteen species of the genus are found within the limits of the United States, and millions of fry must be annually caught in the little bladder traps.

The *Utricularia* occurs in abundance in carp ponds throughout the country, including the United States Fish Commission ponds in Washington, and in some localities has been introduced at considerable trouble and expense, as it was thought to be excellent food for the carp. Prof. Baird will cause every vestige of it to be immediately removed from the Government ponds and will warn carp-culturists everywhere to examine their ponds and destroy any that may be found there.

The specimen received from England has been placed on exhibition in the Fishery Section of the National Museum, where it can be seen by any who are interested in the subject.

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## The Preparation of Shellac Cement.

BY THE EDITOR.

The readers of this JOURNAL are well aware of our very strong predilections for shellac as a cement for microscopical preparations. We have usually advised, as a quick method of preparing it, to dissolve the shellac in alcohol and use it turbid, as it dissolves. Only a portion of shellac is soluble in cold alcohol, so that a clear solution cannot be obtained in this way. If a considerable quantity of an alcoholic solution, not

too strong, be allowed to stand undisturbed for several weeks, the undissolved portion will subside somewhat, leaving a clear stratum above, which may be carefully drawn off and used. This method of obtaining a clear solution of shellac is by no means satisfactory, and, as it is not always possible to purchase it at paint-shops, we give an easy method of preparing an excellent clear solution of shellac. We have used a cement made in this way for years with perfect satisfaction, and quite recently prepared a new supply, having been reduced to the necessity of using the turbid solution for some time past, which, although quite as effective as a cement, is not so pleasant to work with.

To prepare the cement, obtain from a paint-shop a quantity of shellac spirit-varnish, or prepare it by dissolving common shellac in alcohol. It is well to use five or six ounces of the varnish, as there will be considerable shrinkage in volume during the process. Place the varnish in a bottle, which it should not more than two-thirds fill, and add to it about one-quarter of its volume of naphtha or 'petroleum spirit.' In our recent operations we used gasoline, which happened to be at hand, with satisfactory results. Put in the cork and shake well, to thoroughly mix the two liquids. Let the mixture stand a few minutes and shake it again, repeating the operation two or three times. Then let the bottle stand undisturbed for twelve hours, or as much longer as convenient. The naphtha will be found in a layer above the shellac containing the flocculent matter, which, being insoluble in cold alcohol, renders the ordinary solutions of shellac turbid, while the alcoholic solution beneath will be perfectly clear. By means of a syphon, extemporized of a rubber or glass tube, the clear shellac may be drawn off from beneath the naphtha.

The solution thus obtained will be too thin for microscopical use. It

should therefore be placed in an evaporating dish and heated very gently—preferably over a water-bath in which the water is not allowed to boil—until it reaches a syrupy consistence. When cold it will be thicker than while warm, and it should be tested by placing a few drops on a cold slide and watching its behavior. When it seems to be right the solution may be poured into a bottle and about three drops of castor-oil added for every ounce of solution. This causes it to flow smoothly from the brush.

In practice we have found it advisable to evaporate the solution, as above described, until it is quite too thick to flow from the brush, and then to thin it with strong alcohol. The reason is that during evaporation the alcohol of the original solution is driven off more rapidly than the water that is associated with it. Therefore, by the time the solution is reduced to one-fourth its original volume the alcohol has become much weaker than it should be, and the cement dries slowly. By thinning the solution with strong alcohol the resulting cement becomes all that can be desired.

It is well to have two kinds of shellac cement always at hand—one so thick that it will just flow from the brush on the turn-table, the other thinner. The first is useful for making cells, the second as a general cement to attach covers, etc.

—o—

### Microscopical Technic.

On page 92 we referred to a method of making cells used by Mr. C. F. Cox, concerning which a letter from that gentleman appears in the correspondence column of this number.

It appears we were in error as to the composition of the cement used by Mr. Cox, and we can now understand how the mistake came about. This, however, is of no consequence to the reader, as Mr. Cox's formula is now given in full. Munich lake,

which was mentioned on page 92, is a good color, which dries hard, forming an excellent cell of any required depth, and we have used it for making cells with perfect satisfaction.

We may here depart from the strict rule of these articles so far as to give one process which we have not yet tried, but which seems to possess some advantages. Instead of transferring the object from strong alcohol to oil of cloves it may be mounted directly in a solution of balsam in absolute alcohol. This has been done with specimens illustrating animal histology, but we are not aware that it has ever been applied to botanical preparations.

The operation of mounting most objects in balsam is exceedingly simple. The specimen should be arranged on the slide over the central dot, with the turpentine or essential oil,\* as the case may be. The excess of turpentine or oil may be taken up with a clean piece of bibulous paper, and a drop of Canada balsam allowed to fall upon it. By slightly heating the slide the balsam replaces the oil and permeates the object. A clean cover-glass is then applied and the heating continued until the cover-glass is well settled in place, aiding the operation by means of the mounted needles. If the object mounted will stand heat well, the balsam may be hardened rapidly by heating on the mounting table. Otherwise, the slide must be placed in a warm place where the balsam may harden slowly. When it is hard around the edge of the cover-glass the slide may be cleaned by scraping off superfluous balsam with a knife, and removing the last traces with ammonia, alcohol, turpentine, or any other solvent.

We cannot give all the variations to which these processes are subject, but several methods for special purposes deserve to be mentioned. Diatoms are dried upon the cover-glass,

\* Dr. T. Taylor has advised the use of eucalyptus oil in mounting. - See page 119, current volume.



as described on page 73, and this is then lowered upon a drop of balsam on the slide. To mount diatoms *in situ* on algae in balsam, which, in the case of *Isthmia*, *Arachnoidiscus*, *Achnanthes*, and other large forms, is sometimes a very excellent plan, yielding fine slides for dark-field illumination, a method recommended by the late Charles Stodder, is very good. Place the specimen in chloroform and see that the fluid fills all the diatoms and drives out the air. Then transfer them to a slide with considerable of the chloroform, and before this has time to evaporate drop on sufficient balsam dissolved in chloroform to cover them. [As the chloroform evaporates, the balsam takes its place and fills the interior of all the frustules. If air bubbles remained within the latter, their beauty would be much marred.

It is often required to mount objects in balsam which require cells more or less deep. Thus, the beauty of the elytron of the gorgeous diamond-beetle is very much enhanced by mounting it in balsam as an opaque object. It requires a deep cell, which may be made with a glass ring cemented to the slide with any transparent cement—balsam is as good as any. A very neat mount, however, may be made by turning up a cell with benzole balsam in the manner to be described under mounting in fluid. When such a cell is well hardened it may be filled with soft balsam without danger of itself becoming softened, and when the mount is completed it will appear like a solid mass of balsam, no cell being visible. Such a mount must be allowed to harden without artificial heat. The balsam will soon harden outside, but the interior portion will remain soft for years. The reader will recall an article on this subject published in the May number, p. 84.

A very excellent method of mounting in balsam is known as the carbolic acid process.\* This is espe-

cially adapted to the mounting of whole insects without pressure. The insect is dropped alive into the strongest aqueous solution of carbolic acid. In a short time it becomes permeated with the fluid, when it may be transferred directly to raw balsam in a cell.

The use of hard balsam dissolved in benzole or chloroform is much in favor with some mounters. For ourselves we generally prefer the raw balsam that has been hardened by long keeping and bleached by exposure to the sun. This, however, is probably merely a matter of habit, and the dissolved balsam soon hardens on the slide without heat, or the mount may be finished in a few moments over a lamp. On the other hand, there is much shrinkage in volume of the balsam solution in drying, and, when the preparations are put aside to harden, the balsam is very likely to shrink beneath the cover-glass, leaving a vacant space to be filled up at some future time. Moreover, balsam hardens in time so as to become quite brittle, and old balsam mounts will frequently allow the cover-glass to fall off with the slightest jar. This danger is more likely to occur with those mounts prepared with hardened and dissolved balsam, for the reason that the volatile solvent soon passes off, leaving the resin hard throughout, while a mount made with raw balsam may remain more or less soft within for many years.

Dissolved balsam, however, possesses some advantages for certain objects. For example, in mounting small foraminifera or polycystina the dry specimens may be placed on a slide, a few drops of the balsam in chloroform added, the cover-glass laid on, and the slide warmed over the spirit-lamp until the chloroform boils briskly. The air is thus driven out from the shells, and a good mount can be finished in a few moments. It is also thought that in mounting stained vegetable preparations the benzole balsam is to be preferred, as

\* Vol. i, p. 161.

the benzole is supposed to make certain colors more permanent.

To avoid the possible separation of the cover-glass from old mounts some preparers finish their slides with a ring of damar or balsam applied on the turn-table. This makes a neat finish, but when done it is impossible to tell in what medium an object is mounted. It seems better, therefore, to leave all balsam mounts without finishing rings, as a distinguishing characteristic.



### The Selection and Use of Microscopical Apparatus.

We take the following account of a demonstration by Mr. E. M. Nelson before the Quekett Club (London) from the *English Mechanic*. So long as the author does not go too deeply into theoretical discussions of the microscope his contributions to practical microscopy are worthy of careful reading, since he is a practiced and very expert manipulator, having every facility for experimenting, and leisure to devote to it.

Commencing with the choice of a microscope stand Mr. Nelson said the different forms of stands might be broadly divided into two classes: (1) those in which the optical body was supported on a bar or arm projecting at right angles from the pillar-rack, as in Powell and Lealand's, and (2) those known as the Jackson-Lister, in which the optical body had the rackwork applied directly to it and supported by a limb, (two such microscopes, by Swift and Son, were shown as examples.) His own experience was decidedly in favor of the Powell form, as lending itself so perfectly to the application of the best system of fine adjustment that he knew of—the long lever acted upon by a fine screw. Moreover, this form, when properly made, allowed the complete rotation of the stage, and plenty of space for manipulations on the stage. The Jackson-Lister might possess an element of steadiness be-

yond the Powell for use on board ship, (as stated by Dr. Carpenter,) but he could not regard that point as very essential, and it certainly did not compensate for the disadvantages which he feared were insuperable in that model. The application of a good fine adjustment to the Jackson-Lister presented great difficulties. He might at once state his conviction that the fine adjustment attached to the body-tube—the short lever acted upon by a screw—was “radically bad.” He considered Messrs. Swift had hit upon a system of fine adjustment for the Jackson-Lister that was, at any rate, far better than the short lever; they had applied a long lever vertically behind the body-tube, acted upon by a screw at the side, and thus attained an approximation to the certainty and delicacy of the Powell fine adjustment. The Jackson-Lister ought to be a far less costly instrument than the Powell, as machine-work could be employed largely in its manufacture. For the most difficult class of work he gave the preference, without reserve, to the Powell model; it must, however, be thoroughly well made, and must necessarily be a costly stand. He could not regard any microscope as worthy to be called a scientific instrument unless it were provided with a centering substage, and, indeed, he must emphatically urge that scientific microscopy really began with the use of a substage condenser—of which he would speak later on. Regarding the choice of objectives, they should be selected so that the battery might be increased without having to exchange, and without useless expenditure. The beginner might have a  $1\frac{1}{2}$  inch and a  $\frac{2}{3}$ ; later on a  $\frac{1}{4}$  might be added, and as a higher power a  $\frac{1}{12}$  oil-immersion of 1.43 N. A., such as Mr. Powell made so successfully. For all working purposes the battery would then be complete, and the microscopist equipped to repeat any results hitherto obtained. As luxuries a 3 inch,  $\frac{1}{8}$ , and  $\frac{1}{25}$  might be got. It



sometimes happened that the high initial magnifying power of the  $\frac{1}{2}$  enabled the observer to find some hitherto unknown object, or portion of an object, more easily than with the  $\frac{1}{4}$ ; but when once found its details of structure would be better made out with the  $\frac{1}{4}$ . So far it had not been possible to construct a  $\frac{1}{2}$  as perfectly as a  $\frac{1}{4}$ , nor with so high an aperture; hence it would rarely bear any eye-piece beyond the lowest. The  $\frac{1}{4}$ , however, with proper manipulation, would bear the 1-inch eye-piece, and then reveal structure that could not be made out with  $\frac{1}{2}$ 's as hitherto constructed. Half-inch objectives had been made with apertures of  $80^\circ$ . Some authorities had declared that  $40^\circ$  was the highest aperture that could be usefully employed with that focal length. He had obtained one of the best examples of the  $\frac{1}{2}$  inch of  $80^\circ$ , and had made a careful series of trials with it. He had applied diaphragms above the back combination to cut down the aperture to  $60^\circ$  and  $40^\circ$  respectively, and the results might be briefly told. Taking the proboscis of the Blow-fly and viewing it with the  $\frac{1}{2}$  inch diaphragmed down to  $40^\circ$  aperture, and arranging the illumination in the most favorable manner, he noted every detail of the picture, the sharpness and blackness of the points of the bristles, the transparency and clearness and general precision of the image; then removing the diaphragm behind the lens he increased the aperture to  $60^\circ$ , and he found the image improved in every way. Increasing the aperture to the fullest extent,  $80^\circ$ , gave no advance upon the quality of the image seen with  $60^\circ$  up to the 1-inch eye-piece; for this reason he concluded that  $60^\circ$  was the really useful aperture for a half inch, and gave as much resolving power as the eye could well sustain with that combined power. No doubt the extra  $20^\circ$  would give the lens a higher resolving power with a stronger eye-piece, but he thought that might be better obtained with a lens of shorter

focal length. In the matter of eye-pieces, so far as he had not done useful work with anything higher than the one inch, except in adjusting the correction collar in testing the objectives. With reference to the question of the relation of aperture to power, he alluded to a note already communicated to the club in which he had said that by experiment he found that the normal eye was capable of defining objects at a distance of 10 inch, making an angle of  $1' 23''$ —that is to say, it was capable of separating lines ruled at the rate of 250 to the inch. Applying this to microscopical vision with a half inch the question was, What aperture was necessary to enable it to resolve anything that would be brought to that visual angle by an amplification of ten times its initial power? For example: the half inch having an initial power of twenty, with a 1-inch eye-piece would magnify 200 diameters; multiplying the last figure by 250, we obtained the product 50,000; an aperture of  $63^\circ$  would be required for the resolution of lines of that fineness. He might warn microscopists generally of the immense number of grossly defective eye-pieces that were offered for sale. The Huyghenian eye-piece should be constructed so that the radius of curvature of eye-glass to the field-glass should be as 3 : 1. Certain manufacturing opticians had entirely lost sight of the formula, and they made the same field-glass do duty for eye-glasses of different foci. The result was lamentable. Well-made eye-pieces were most essential to good work with the microscope. Here, again, he could bear testimony to the conscientious accuracy of Messrs. Powell and Lealand, who had not departed from the strict Huyghenian formula for eye-pieces. On the use of daylight he said he found it effective for low powers up to  $\frac{2}{3}$  inch, and with condenser up to  $\frac{1}{4}$  inch. The direct sunlight involved the use of a heliostat, otherwise the continued adjustment of the mirror was irksome.

Where strong resolving power was needed, oblique pencils of sunlight from the heliostat would outrival any other illumination; but much care was necessary not to injure the sight, and on the whole he could not recommend its general use except for photographing. Diffused daylight was too uncertain—too variable—for accurate testing of objectives. It was not possible to get with diffused daylight the absolutely best image that an objective would produce. A really critical image could only be seen with artificial light, and with a good condenser and diaphragms. He did not mean to say that no good work could be done with diffused daylight, for excellent work was done with low or medium powers; but he insisted that it was not possible to do any such critical work as testing objectives by daylight as thoroughly as it could be done by artificial light. With daylight and mirror only there was milkiness, and what he might term “glaze.” The milkiness could be got rid of by a diaphragm, and the “glaze” by using a ground glass behind the object. Unless a condenser were used there would always be found a falling off of the quality of the image with all powers higher than  $\frac{2}{3}$ . From long experience in working with the microscope he felt justified in asserting that on the whole daylight was more trying to the sight than lamp-light. Every one would understand the importance of keeping off stray light from the stage, &c. An ordinary paraffin lamp having a wick of half an inch would answer most purposes admirably, and with low powers ground glass should be employed either with or without condenser. The image of the flame could be projected in the ground glass, nearer or further from the object. The oxy-hydrogen light might be serviceable for resolving such tests as Nobert’s lines. The incandescent lamp he regarded as entirely a failure for microscopical purposes.

(To be continued.)

## EDITORIAL.

**Publisher’s Notices.**—All communications, remittances, exchanges, etc., should be addressed to the Editor, P. O. Box 630, Washington, D. C.

Remittances should be made by postal notes, money orders, or by money sent in registered letters. Drafts should be made payable in Washington, New York, Boston, or Philadelphia.

Subscription-price before April 1st, \$1 per year, in advance. All subscriptions after this month begin with the January number. After April 1st the subscription-price will be \$1.50.

The regular receipt of the JOURNAL will be an acknowledgment of payment.

**AMERICAN SOCIETY OF MICROSCOPISTS.**—The meeting of the American Society this year takes place at Rochester, N. Y., beginning on the 19th of August, and continuing four days. The British Association meets at Montreal on the 27th of August, and the American Association at Philadelphia, beginning September 3d. Those who desire will, therefore, be enabled to attend the three meetings.

The meeting at Rochester promises to be well attended, and great preparations are in progress, in anticipation of a large gathering of microscopists. On page 117 of the June number will be found a note in regard to a series of demonstrations of practical work, which promise to be a useful feature of the meeting. The Rochester Academy of Sciences has made announcement of a soiree to be given on the 21st inst. ‘It is desired that the exhibits be as numerous and complete as possible, and all microscopists are invited to assist on that occasion. The committee in charge desire to ascertain at the earliest practicable date how far they can rely upon the co-operation of members and others; the number of microscopes for which to provide tables, illumination, etc., in order to intelligently make the proper arrangements.’ A blank is sent out with the announcement, to be filled up by intending exhibitors. It has been carefully prepared and ought to serve its purpose well. It bears evidence that the preparations are in charge of competent and energetic persons, and



the ultimate results of their efforts must depend upon the co-operation of others. Members should not delay replying to the circular and filling the blanks with care. Correspondence should be addressed to Chas. E. Alling, 45 Tremont st., Rochester.

We have received the following communication from Mr. Griffith, dated July 5th, which we hasten to publish:—

‘It has been decided to devote at least one hour of the working session of the Rochester meeting to questions and answers relating to any department of microscopy. In order to save time, also to secure a chapter of valuable information for the “Proceedings,” the questions should be sent in writing to the undersigned immediately, so that they may be distributed among the proper persons for written answers, to be read and discussed at the time designated. Veterans in any work, especially in microscopy, are often asked simple questions which they are unable to answer, and amateurs often desire information which they are unable to find in books. No names will be read in connection with such communications, and it is earnestly desired that practical questions, no matter how simple, will be sent in at once. If you desire for yourself, or for the benefit of others, information on any department of microscopy, please sit down at once, write the questions, and send them.—E. H. GRIFFITH, Fairport, N. Y.’

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THE AMERICAN AND BRITISH ASSOCIATIONS.—From *The Naturalist's Leisure Hour* we copy the following, which, coming from Philadelphia, may be regarded as conveying correct if not official information:—

‘The Council of the British Association has invited the fellows of the American Association to join in the meeting at Montreal on the footing of honorary members, and the American Association and the local commit-

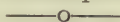
tee of Philadelphia have invited the members of the British Association, with their near relatives who may be with them, to take part in the Philadelphia meeting. \* \* \* The probabilities, therefore, are that the Philadelphia meeting will be largely international in its character. \* \* \*

‘The local committee are actively engaged in perfecting their arrangements for the accommodation of the large number of persons which the unusual circumstances will call to Philadelphia; and while the contemplated arrangements provide for two thousand members of the Association, it is earnestly requested by the committee that they be notified as early as possible of the intention of members and their families to be present. \* \* \* The hotels have agreed to reduce their rates to the members of the Association, and lodgings will be available at from one to four dollars a day. \* \* \*

‘A series of receptions will be offered the Association and its guests, including one at the Academy of Music after the President’s address; a reception at the Academy of Fine Arts, a garden party at Haverford College, and a microscopical exhibition at the Academy of Natural Sciences. \* \* \* There will also be visits to the International Electrical Exhibition, the Zoölogical Gardens, Fairmount Park, Independence Hall, and other places of interest, and the various institutions in the city will welcome the Association to their halls. During the meeting five excursions will be offered, to the seashore, the anthracite coal regions, and other places of interest, and possibly limited excursions to more distant points after the meeting. Special botanical and geological excursions will also be given.’

The official announcements of the meeting have not yet reached us. The permanent secretary of the Association is Prof. F. W. Putnam, who may be addressed at Salem, Mass. Prof. H. C. Lewis and Dr. E. J.

Nolan are secretaries of the local committee, Philadelphia.



THE ELECTRIC LIGHT IN MICROSCOPY.—Last month we referred at some length to the use of the electric light for illuminating objects under the microscope, and proposed this month to treat briefly of another part of the subject. Dr. Max Flesch\* has written an able article in which the electric light is considered as to its value as a source of light for this purpose.

The value of a light for microscopical purposes can be determined by considering the causes which influence the capabilities of a microscope. It is well known that greater resolving power is obtained with blue than with white light. Accordingly, it is the quality of the light—the relative proportion of light-waves of short wave-length, or, as we may say, of rays near the blue end of the spectrum—that must be considered. 'The limit of resolution of the microscope, which cannot be extended under present conditions, depends upon the illumination, and under the most favorable conditions it does not exceed with the most oblique light  $\frac{3}{8}$ , or with perfectly central light  $\frac{3}{4}$ , of a wave-length (about  $0.55 \mu$ ) of white light. With illumination by homogeneous blue light of about  $0.43 \mu$  wave-length (Fraunhofer's line G), under the same circumstances, the limits above expressed become reduced to about  $\frac{3}{10}$  and  $\frac{6}{10}$ , respectively; that is, to about  $0.15 \mu$  and  $30 \mu$ . The possibility which the foregoing indicates to increase the capabilities of the microscope by the use of blue instead of white light makes it desirable to introduce illuminating apparatus which permits of the ready application of monochromatic light. Upon these grounds Dr. Van Heurck has already applied the electric light to microscopical work with excellent results, and he

has thus explained why it is better for the study of minute details than the yellow light of an ordinary lamp. In the article by Dr. Flesch this subject is considered at some length with reference to the proportion of blue rays available in practice. As is well known, the proportion of rays of different colors emitted by an incandescent body is dependent upon the temperature. At  $1500^{\circ} \text{C}$ . bright blue rays are emitted, at  $2000^{\circ}$  violet rays. In the case of the electric light the proportion will vary with the strength of the current. E. O. Meyer, who has published an article entitled 'On the Color of the Electric Light,' gives the following proportions for the different lights examined by him:—

	Arc Light.	Incandescent Light.	Gas Light.
Red.....	2.09	1.48	4.07
Yellow.....	1.00	1.00	1.00
Green.....	0.99	0.62	0.43
Blue.....	0.87	0.21	0.23
Violet.....	1.03	0.17	0.15
Extreme violet.....	1.21	—	—

The above table represents the brightness of the several lights compared with that of the sun, the latter being reduced in intensity until the yellow was the same in each case. The incandescent lamp employed was one of Edison's form.

It will be seen that the incandescent light contains, relatively, more of the blue rays than gas light. This light, it may be concluded, possesses the advantages of ready application, comparatively little heat, considerable intensity, and an abundance of rays of short wave-length. It may readily afford monochromatic light, without undue loss of illumination.

Another great advantage of this light, which would seem to commend it, especially to those who use the microscope in lithology, and also for the examination of stained preparations, is the color of the light, which shows colored objects nearly the same as they are seen by daylight.

Last month we suggested that dealers might do well to provide electric lamps suitable for use with the mi-

\* *Zeitschr. für Wiss. Mikr.*



croscope to be run by a small battery. Such batteries are being made which are unobjectionable in the house, and quite economical to maintain. A further study of the subject strengthens our conviction that the electric light is to be largely used by microscopists in the near future.

Since the above was written we have learned of a small electric lamp which has been proposed for this purpose. When we have an opportunity to test its value and convenience for ordinary use, our readers will hear more of it. From Mr. Zentmayer we learn that the Franklin Institute has appointed a committee to experiment upon the subject of electrical illumination for the microscope and lantern. The work is to be done before the opening of the electrical exhibition, which is to be held in Philadelphia in September, and the results will doubtless then be made known.

Some time ago the idea occurred to us that for lantern purposes the best possible light would be produced by placing a piece of lime between the carbons of an arc light, which, being intensely heated by the current, would give out a strong and very steady light. When opportunity permits, we purpose making a practical test of the matter; but in the meantime perhaps some one engaged in the experiments at Philadelphia will make the trial.

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### NOTES.

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—V. B. Wittrock, the celebrated algologist of Stockholm, states that the algæ of the snow and ice of the Arctic zone include numerous species. The snow-flora comprises about forty species and varieties of the fresh-water forms, and the ice-flora about ten, belonging to twenty-five genera.

—The eminent Mr. Pasteur announced some time ago that he had discovered the active agent of the dreaded disease known as rabies, and, later, that he had been able, by inoculation, to render dogs or persons

proof against its attacks. This surprising announcement has been received with considerable doubt, and, recently, Mr. Pasteur desired to have a commission appointed to test the matter by experimenting upon dogs. An opportunity has now been offered to make a practical test on a human subject. An employee of the Paris and Lyons Railway at Tarascon-sur-Rhone, having been bitten by an undoubtedly mad dog, has placed himself in the hands of the eminent savant.

—We have received some sample slides from Prof. John Peirce, intended to prevent the drying of specimens during several hours' continuous observation. A rather deep circular cut is ground in the middle of each slide, about half an inch in diameter, which is intended to hold a sufficient quantity of the water to prevent evaporation from under the cover within the cut. It is expected that physicians will find these slides useful. They may be purchased of Mr. R. L. Allen, Providence, R. I.

—While in New-York not long ago, we heard of an objective of somewhat novel construction recently made by Mr. William Wales. It was a high-power lens, either an eighth or a twelfth-inch, according to our present recollection, mounted so as to be used in a binocular microscope. Not having seen the objective, we can only repeat what we heard concerning it, from which it appears that the optical part was mounted in a thin disc of metal like a silver quarter-dollar piece, which screwed into the nose-piece. The object was, obviously, to get the lenses as near to the binocular prism as possible. We are unable to add anything as to the results obtained.

—There are several meetings this summer which deserve the attendance of microscopists. It is well, however, that our readers should be reminded thus early of the meetings, in order that they may be fully prepared for them. The one which has, perhaps, the first claim upon microscopists is that of the American Society of Microscopists, which takes place in Rochester, N. Y., during August. The American Association meets a little later at Philadelphia, and it is hoped the section of histology and microscopy, of which the Editor of this journal is Secretary, will be well attended. The British Association also meets, in Montreal, in August, and this will, doubtless, attract many persons interested in science, not only for the privilege of the meeting, but also to meet

with the eminent men of science from England, whose names are familiar to us all.

## CORRESPONDENCE.

### Cement for Mounting.

TO THE EDITOR:—In one of your issues you kindly referred to the finishing cement used by me on my slides, but you got a little astray as to the material I employ. I don't know anything about the color you mention. As a matter of fact, I use one of C. T. Reynolds & Co.'s coach colors, either ruby lake or body lake, which I mix with the ordinary asphalt. I cannot give the proportions exactly, because it is a matter of experiment from time to time. I mix them until I get the shade and consistency I like. The coach color, if used alone, would dry almost immediately into a solid dead mass, like brown putty. Mixing it with asphalt produces a cement which builds up easily, dries rapidly, and sets firmly, with a half shiny, half dead surface resembling chocolate. The coach color by itself is likely to crack when dry, but the mixture never cracks if properly made. I know of no cement for dry mounting which has as many good qualities as this one.

C. F. COX.

### Glycerin in Mounting.

TO THE EDITOR:—In regard to your editorial remarks upon the use of glycerin, pages 15 and 16 of current volume, a part of the trouble may be deduced from this sentence: 'The great value of glycerin in mounting arises from its density and perfectly neutral character.' Now it is much easier to find glycerin which is not perfectly neutral than *vice versa*. However crude the test may appear, the simple application to the tongue of various samples of glycerin will reveal the fact. Common samples of glycerin leave a distinct after-taste of a fatty acid.

Price's glycerin is free from this disagreeable taste. It is a matter of certainty, therefore, that if the preparer use an acid glycerin in delicate specimens, and one almost surely also lacking in density, chemical and physical changes are right-fully to be looked for.

I may instance a proboscis of the house-fly prepared and mounted unpressed in Price's glycerin two years since. Some observers might say it is too transparent; no one would accuse it of granularity.

Dr. Beale's directions for using glycerin even for zoöphytes are explicit. 'All that is required is, that the strength of the fluid should be increased very gradually [from sp. gr. 1050] until the whole tissue is thoroughly penetrated by the strongest that can be obtained.' 'How to Work,' 5th edition, page 362. It is hard to resist the conclusion that those who complain of granular specimens fail in purity of glycerin or in patient and faithful preparation of specimens.

EDWARD GRAY,  
A. A. Surgeon, U. S. Army.

### Device for Mounting.

TO THE EDITOR:—I have before me a very ingenious contrivance for mounting microscopic objects, devised by Mr. G. C. Hinman, of this city. It consists of a perforated plate with the edges turned up, so as to receive a glass slip, and hold it with the centre over the centre of the perforation, thus enabling the object to be placed centrally without difficulty. When the object is mounted, this plate is placed upon another under a spring having three points in a plane parallel with the surface of the slip, which can be pressed down upon the cover-glass with any desired force, and thus bring the cover-glass into a plane parallel with the slip. This is by far the most convenient instrument for holding the cover-glass in place I have ever seen.

J. H. PILLSBURY.

JUNE 1st, 1884.

## Exchanges.

Exchanges are inserted in this column without charge. [They will be strictly limited to mounted objects, and material for mounting.]

Echinus spines of various species offered to any person who will send in return three good sections of the same.

Box 630, Washington, D. C.

Wanted.—Diatoms on seaweeds and in muds, from all the tropic seas. Offered a large quantity of fine selected diatoms and other slides, or cash.

J. C. RINNBOCK,  
14 Simmering, Wien, Austria.

Will exchange well mounted slides for others well mounted.

H. H. PEASE,  
1271 Broadway, N. Y.

Living red *Astasia nematodes* (*Euglena viridis*) and *Volvox* sent on application, or mounts of the same in exchange for algæ, fungi, or infusoria.

J. M. ADAMS,  
Watertown, N. Y.

Will exchange various mounts of crystals for other slides, and material for mounting.

JAMES E. WHITNEY,  
Rochester, N. Y.



# THE AMERICAN MONTHLY MICROSCOPICAL JOURNAL

VOL. V.

WASHINGTON, D. C., AUGUST, 1884.

No. 8.

## Growing Slides or Microscopical Vivaria.

A good growing slide, in which minute organisms may be kept alive for days or weeks, is of great value to a microscopist. It is useful not only for purposes of study, but also for exhibiting objects to friends or at public gatherings. It is very troublesome to prepare minute and delicate living objects for exhibition, when they have to be sought for in a bottle of water that has been carried about from home to the place of meeting. The chances are that they will not be found at all, and if they are found they are not likely to be shown to good advantage, owing to the haste in preparation.

It is far better to put the specimens in a live-box or zoophyte trough at home, and the latter may be carried about upright in a large bottle of water.

The importance of this subject induces us to repeat, with some additional details, the descriptions of two forms of growing slides, which have already been given in these columns. The first is the growing slide devised by Mr. T. Charters White, which he described before the Quekett Club about three years ago.

'The sides, which may be of any dimensions for which you can get thin glass covers, are constructed out of the strips of thick plate-glass. Having built up a cell with these, to a suitable and convenient size, cement a piece of the same plate-glass in the centre of the cell with Canada balsam. You have now a water-tight cell with a table of plate-glass in the centre, the space round which you

may fill half up with water. Placing the infusoria, or whatever the object may be, on this table in water, cover it with the thin glass, and the water in the trough will keep up the loss by evaporation.'

'Such a slide must be used with the microscope vertical, which is a decided objection. A more generally useful growing slide, or vivarium as he prefers to name it, was described by Mr. J. D. Hardy before the same



FIG. 24.—Hardy's Vivarium.

club at about the same time. We reproduce the drawing in fig. 24. It consists of two plates of glass, three inches long by two wide, with a ring of glass or other material, having part cut away as shown in the cut, between them. The plates are held together by rubber bands, and the joints are made tight by grease or other material. The author says:—

'To use it, take off the upper glass, and having cleaned both glasses, place the object on the lower glass, manipulate it to the best advantage, replace the upper glass, and then fill up with water through the hole at the top. It will be found that the cell is reversible and that it can be plunged into a beaker full of water in any position without any fear of losing the object.'

## Phialonema Cyclostomum, Stein.

BY DR. A. C. STOKES.

Having found this minute creature in some numbers gliding over the decaying leaves and water-soaked twigs at the bottom of a shallow little pool, the fact seems worthy of record on account of the animalcule's apparent rarity, and because the writer has noted certain points of structure and habit, perhaps of passing importance, yet not set down by former observers.

Stein's work on the Infusoria consists at present of illustrations only, and the scientist who formulated the published generic diagnosis of this animalcule did so by describing Stein's figure. It is probably for this reason



FIG. 25.—*Phialonema Cyclostomum*, Stein.

that the American form differs somewhat from the detailed account of the genus to which it undoubtedly belongs. The generic diagnosis states that *Phialonema* is persistent in form, whereas the specimens taken from my little pool are quite elastic. I have witnessed them suddenly and quickly contract into a semi-globose form, with the dilated and obliquely-set oral extremity almost eliminated; I have seen them variously compressed and indented, and with the posterior region twisted or folded.

The description of the species says that the flagellum of this flask-shaped creature is short, nearly equalling the body in length. In my specimens this organ exceeds the length of the body, and is retractile. The latter accomplishment the creature seldom puts into practice; it has not been before noted. The pharynx is short, not exceeding one-fourth the length of the infusorian, and apparently does not end in a bulbous enlargement. The body is conspicuously striate, sometimes ridged, obliquely. Its movements are somewhat rapid, the large oral aperture being held in con-

tact with the slide or supporting object, the long flagellum distinctly vibrating only at its distal extremity. The length of the body is  $\frac{1}{100}$  inch; that of the typical species  $\frac{1}{500}$  inch.

When the German discoverer's description shall be published it will probably be found to include infusoria with flask-shaped, obliquely striate, elastic, and colorless bodies, pointed posteriorly, prolonged anteriorly in a neck-like manner, the expanded oral aperture circular, truncate, and obliquely set, the rim thickened; pharynx curved, tubular, at times extending to or beyond the centre of the body, its distal end occasionally much dilated; cuticular surface spirally striate or ridged; flagellum vibratile, retractile, often longer than the body; nucleus subcentral; contractile vesicle anteriorly placed, at one side of the pharynx. Length of body  $\frac{1}{1000}$  to  $\frac{1}{500}$  inch.

Taking into consideration the differences between my find and the type as published, I think it desirable to record the infusorian, if not identical with *Phialonema cyclostomum*, at least only as an American variety. It is shown in figure 25.

—o—

## A Rapid Method for Making Bone and Teeth Sections.

BY EVERETT T. NEALEY, M. D.

An article in the *Journal of the Royal Microscopical Society*, 1884, page 304, by Mr. J. E. Ady, forcibly brings to mind the laborious character of the methods in common use by workers upon teeth and bone preparations.

I have spent some time trying to follow out the instructions usually recommended in text-books, gluing thick, sawed sections to slips of glass, and after grinding and polishing one side, turning the sections over and following the same course upon the opposite side. As the section necessarily became dry and brittle, I at last gave up the plan as unsatisfactory, especially for one having other



business to attend to, or who does not care to devote all his spare time to the perfection of a single mount.

Thinking that a simple method of grinding used by myself for some years past would be of advantage to your readers, I send the following.

I have elsewhere noticed a short article by Mr. Jacobs upon making sections of teeth with pulp, in which he describes very nearly the same method of grinding. But as I have a little more to say upon this subject, I take the risk of repeating some things, as the subject will surely bear recapitulation.

I use nothing but perfectly fresh tissue, which I take to a dentist's office, where one generally finds a good polishing lathe with a set of emery wheels, and rapidly grind down one side after another of a tooth or sawed section of bone by holding the same firmly between my fingers and thumbs against the edge or circumference of a coarse stone. In a few minutes I am thus enabled to grind down a rough section to about  $\frac{1}{16}$  of an inch in thickness. I keep the section and stone thoroughly wet in cold water, to keep it moist and cool. As the section becomes too thin to hold as before, I wet the evenly sawed end of about a one inch cube of soft pine block, and place the tooth upon this, where it is held sufficiently secure upon a firm and even bed. I then press the section against the side of a finer stone, and after working it down reasonably thin I change it to the finest and best polished stone a dentist makes use of.

In polishing, instead of the block I often make use of the palmar surface of my index finger, and I now prefer it. It is simply surprising to see how easily and delicately one is enabled to do this with a little practice. If a part of the ball of the finger happens to come in contact with a finely polished and well-moistened stone it will have but little if any effect upon the epidermis. I generally make use of a lathe run by a water

motor, but foot-power answers quite as well. In this way I can have a tooth ready to mount in thirty minutes after its removal from the jaw.

The above method has the following advantages over the old and more common ones, viz., rapidity of preparation, and thereby the specimen retains all of its original tenacity. It does not curl up or become brittle, and thus one is enabled to get a larger and more perfect specimen. During the reduction and polishing the specimen can readily be removed from time to time, washed, and the process of reduction observed. I have made perfect longitudinal sections of teeth in this way which were so thin that they would bend under their own weight. This would be simply impossible in a tooth that had become dry during the old process, as they become too brittle to allow of such extreme reduction.

A tooth may be ground to its centre, and the pulp kept hard by immersing it in alcohol from time to time, as suggested by Mr. Jacobs, but I have not found this necessary when a reasonable amount of care is used. The pulp may then be stained, and a very pretty and instructive mount it makes. I have a section of cat's jaw, with tooth *in situ*. The bone corpuscles in the lacunæ of the jaw-bone and the pulp of the tooth have been stained with Thirsch's carmine borax stain. The rapidity of reduction and preparation thus readily admits of staining the protoplasm of bone sections before retrogression sets in, and thereby their value is greatly enhanced.

I make use of the usual methods of dehydrating and staining, and I generally clear in benzole or carbolic acid and spirits of turpentine, one part to five, and mount in balsam.

[A well-made section of a tooth within its socket is a very fine specimen for exhibition. We have one made by Mr. J. L. Williams, which was purchased some time ago because of its excellence, and it has proved of

great interest to many persons who have seen it. Such an expeditious way of making the sections should lead many to prepare them. A cat's tooth furnishes a section of very good size for examination. We have since been led to believe that Mr. Williams' section was made by the process described above. If so, it is good proof of the excellence of the method.—ED.]

—o—

### Pond Life in Winter.

Noticing some observations on the above subject, and being myself for many years an ardent 'pond man,' I will, with your kind permission, give an instance or two of my success in this little worked-out line of biology (especially in America) as regards pond hunting in the winter months. As far as my records go I have found very little difference. I am generally as successful on a winter's day as in the summer time, for in the hot weather you may go to pool after pool, ditch after ditch, and find nothing but thin mud perhaps, the result of continued drought. Then only fairly large lakes or reservoirs can be of any service, and these are generally very low and muddy round the borders and require some care, or else up to your knees you go unless you have a good drag to send across. Last winter I thought to venture out for some material for study, and I visited a large reservoir not many miles from Birmingham. The ice was very thin on account of a slight current. I dragged that pool, and that one haul sufficed to keep me fully employed for a month or more. I will briefly state what I found in that one haul on the weeds, *Anacharis* and *Myriophyllum*.

1st. That beautiful compound creature *Dendrosoma radians*; there were many, very many, large colony stocks. I saw several much larger than the one figured in Saville Kent's Manual, with the ciliated embryos tolerably plentiful in the water swimming about. I took a fine gathering

at the time to Mr. T. Bolton. Also *Trichophrys epistylides*, *Podophrys cyclopeum*, *Acineta grandis*, a new species, *A. mystacina*, *A. cemmurum*, *Raphidiophrys elegans*, *R. pallida* Schultze, *Actinophrys sol* and *Eichornii*, *Stichotricha remex*, *Arcella vulgaris*, *dentata*, *aculeata*, *Amæba villosa*; also *Stephanoceros Eichornii*, very plentiful and very large; *Melicerta ringens*, *Cephalosiphon limnias*, *Limais ceratophylli*, *Vaginicola*, *Æcistes*, *Cothurnia*, *Epistylis digitalis*, *Opercularia*, *Floscularia regalis*, *ambigua*, *ornata*, three species of *Anurea*, three of *Brachionus*. I have also generally managed to find *Volvox* in the winter in one pool or another, frequently under thick ice. Some years ago I found the most beautiful gathering I ever found of *Volvox* under the ice. They were very large and plentiful, showing the beautiful yellow encysted, or, as it is called, 'resting stage.' The *Dendrosoma* I had under the microscope for weeks, hoping to be able to see for myself what is spoken of by Mr. Leveck in the Manual, the genetic process of multiplication, but so far have not been successful. I generally go pond hunting twice a week. I frequently walk 15 or 16 miles where there is no kind of railway, and in all weathers, and so far as my experience goes I like winter almost, if not quite, as well as summer; for a long journey with a lot of glass bottles and other apparatus fags one so. I can fully agree with your remarks in your JOURNAL regarding the way in which this kind of study is neglected in America, as it appears to be. I think the microscopists in England are much more devoted to pond life on the whole than the Americans appear to be, and in such a glorious hunting ground, too, as, in my opinion, is pretty well proved by the beautiful work just published on Desmids of the United States by Mr. Wolle. I am truly delighted with it, as it contains so many examples in addition to Ralf's work.



I have recently discovered *Xanthidum antilopæum*, *Arthrodesmus Incus*, *Staurastum Sebaldi*, *Cosmarium Pseudonitidulum*, and a few very rare forms in a sunken pool.

In conclusion, I often regret that there are so many microscopists who neglect this useful, healthful, and fascinating branch of study. Do any of the American microscopists keep aquaria? I have kept aquaria of one kind or another for over twenty years, but only the last four years for the microscope, and have tried *Vallisneria*, *Anacharis*, *Nitella*, *Chara vulgaris*. For breeding rotifers, and for harboring them, nothing, I find, comes up to *Chara vulgaris*. The tubedwelling rotifers love to build their habitations in the axils of the whorls and in close proximity to the beautiful red bunches of fruit; this plant is better even for this purpose than *Nitella*, and that is also very good. I have at present about twenty tolerably large aquaria in my room, all with *Nitella* and *Chara* in abundance, and fairly covered with *Meliceria ringens* and *M. tyro*, *Stephanoceros*, and many others too numerous to mention here.

E. H. WAGSTAFF.

BIRMINGHAM, England.

### Dr. Koch's Studies of Cholera.

Though I live on the other side of the world, I am a subscriber to and constant reader of your JOURNAL; and as I see you frequently refer in your pages to bacteria and bacterial pathology, I have sent you by this mail a copy of one of our local papers, which contains two articles on Professor Koch's recent discovery of the bacillus associated with cholera. As you are doubtless aware, he was sent out by the German government, with two other savants, on a commission to investigate the causes, etc., of cholera. He went, in the first instance, to Egypt, where he discovered the specific bacillus, but only in the human body and in the dejecta of

the disease. From Egypt the commissioners came on—I rather think at Professor Koch's own suggestion—to India. In Calcutta he for the first time discovered the bacillus in a tank in the neighborhood of which cholera of a virulent type was actually raging. If you could get the perusal of the May number of the *Indian Medical Gazette*, you will find the translation it contains of Professor Koch's sixth report to his government very interesting.

There are two or three points in connection with the articles in the *Indian Daily News* that to me seem to call for attention: One is the suggestion to use acidulated enemata in the early stages of the disease; another, the view that the bacillus may set up a process allied to fermentation, and thus convert the fluids of the intestine into a specific poison; and finally, the hypothesis that the bacillus of cholera does not enter the human system by the mouth or the nostrils, but gains admission from the other extremity of the alimentary canal. To specialists these hypotheses would probably suggest experiments which might result in the discovery of facts that would give us a better control over cholera than we now possess. Your position as Editor of the AMERICAN MONTHLY MICROSCOPICAL JOURNAL, and the wide circulation of your magazine, induce me to call attention to matters which in these days of bacterial pathology may possess some interest for your readers, and to send you the *Indian Daily News* by this mail.

W. J. SIMMONS.

CALCUTTA, May 28th, 1884.

### The Selection and Use of Microscopical Apparatus.

[CONTINUED.]

This was at once obvious upon the consideration that the finest images seen are got by viewing objects, as it were, in the image of the source of light. All critical images of transparent objects viewed by direct transmit-

ted light required first that the source of light should be pictured by the condenser exactly in the plane of the object, the object then served to interrupt the image of the source of light. The observer had simply to arrange the lamp, condenser, and diaphragms so as to produce the most perfect image of the source of light of the required size in the plane of the object, the objective would then have fair play. The size of the image of the lamp flame could be controlled by distancing the lamp, as illustrated by a diagram. There really was no other secret in the matter. With the incandescent lamp the image produced by the condenser represented the mere carbon thread, on which no object could be seen projected; in order to obtain some extent of brightly luminous field the condenser must be put out of focus; then the intensity of the light was so reduced that the observer would simply discard the incandescence, finding it far less serviceable than a shilling paraffin lamp. He had himself suggested the construction of a lamp for use with the microscope, in which the flame could be brought very low down near the table. The glass of the chimney consisted of an ordinary 3 by 1 slip, and so could be cleaned or replaced readily. The chimney was of metal, and he preferred it black inside; he wanted the image of the flame on a black background. The bull's-eye of the ordinary construction gave but a small disc of clear light; he had therefore engaged Messrs. Swift to construct a condenser for the lamp on the Herschelian form, consisting of a meniscus and a bi-convex, which gave a much larger and clearer disc of light, as shown by diagram. He did not advise the use of the bull's-eye for direct transmitted light; it was preferable to point the microscope direct to the flame, or to use the plane mirror. The bull's-eye was useful for oblique light, especially when a double-slot diaphragm was required. It was very important for dark-ground illu-

mination, and with the Lieberkuhn. Oblique light with single-slot diaphragm he obtained better without bull's-eye. In treating of the use of condensers he could not too strongly dwell upon the importance of proportioning their aperture and power to those of the objectives. In his judgment no condenser had yet been devised so effective as Powell and Lealand's for all powers beyond  $\frac{1}{4}$ . It had an aperture of about  $170^\circ$ , and a focus long enough to go through any ordinary slip, and was provided with a beautifully centred disc of graduated diaphragms, and with slots and central stops of admirable construction. Whilst giving it the palm over every other form of achromatic condenser, he was alive to the fact of its being costly. It was so well made that it must be costly. Its convenience was so great that he could hardly suppose that any one who had once gained experience of its utility would consent to use high powers without it. He regarded it as the most useful apparatus in his collection. Messrs. Swift have produced a condenser of  $145^\circ$  degrees aperture, which, by removing the front lens, could be reduced to a much lower aperture suitable for low powers; it had a pivoted disc to carry the diaphragms. The microscopist should possess both these condensers to enable him to do critical work with high and low powers. With Messrs. Swift's condenser it was advisable to have an adapter to fit beneath and carry three concentric rotating rings, which were specially convenient for experimenting with central stops; or for zonal illumination. The superposition of two or three discs differently cut gave a great range of effects of light. They might also be used for selenites and mica, and would be found of great service in this combination. He entirely condemned the use of paraboloids for dark-ground illumination. Properly-adjusted central stops with the condenser would give by far the best dark-ground illu-



mination. For opaque objects he thought nothing had been devised so good as Lieberkuhns, and objects ought as far as practicable to be mounted for use with Lieberkuhns, and not covered up with paper. If the side illuminator were used it should be attached to a fixed part of the stand, not to the body-tube or stage. The vertical illuminator was a difficult apparatus to manipulate, and required great patience. It afforded a remarkable proof of the existence of aperture beyond the dry-lens limit. He exhibited a diagram of the back lens of a  $\frac{1}{12}$  oil immersion objective of 1.43 N. A. when used with the vertical illuminator; the outer zone represented the aperture beyond 1.0 N. A. The first requirement with the vertical illuminator was to find an object in close adherence to the cover-glass, for it was only such an object that lent itself to that method of illumination. He was afraid he could not say anything useful on that matter unless supported by the microscope; but he had repeatedly exhibited the apparatus at the club, and therefore he would not then dwell further upon it. As a camera lucida he had been satisfied with Beale's neutral tint reflector. On the use of the eye-piece screw-micrometer he said that for delicate measurements it should be mounted on a separate stand not to touch the microscope; in that way he had repeatedly counted 90—100 lines in the whole space of an inch. As to polarisation, he had so little time left that he must be content with the simple recommendation of polarisers with large field. He might, however, remark that many minute objects gave curious effects of polarisation—for instance, the Podura scale—and many of these yielded most beautiful pictures when viewed with polarised light. He then referred to the diffraction appearances presented at the back of objectives in viewing *A. pelucida* by axial light and again by oblique light, using, in both cases,

dry and immersion condensers. He also showed by diagrams the progressive interpretations that had been made of the structure of *P. angulatum* and *P. formosum* during the past 50 years, and concluded by some general observations on the difficulties of interpreting the images presented by microscopic objects requiring high magnification.

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### Microscopical Technic.

MOUNTING IN FLUIDS.—We would not care to undertake the task of enumerating the numerous fluid concoctions that have been recommended from time to time for mounting microscopical specimens. Most of them are good enough in their way, but possess no special merit whatever, and are no better than those mentioned in every book on mounting. A reference to page 51 will indicate by what rule the liquid to be used should be selected. For very delicate and finely marked specimens—such as grains of starch, for example, in which it is desired to show the concentric markings as clearly as possible—water is unquestionably the best medium. For other specimens which are less transparent, and for injected or stained histological specimens, glycerin is to be recommended, and by mixing water and glycerin in various proportions media can be prepared suited to any specimen. Further on will be given the composition of a number of fluids for mounting that have been proposed by mounters of experience. At this place it may be said that as a rule water, glycerin, and mixtures of these, will answer all ordinary requirements. It is usual to employ camphor water, which is water that has been kept in a bottle with a piece of gum camphor, or else water containing a trace of carbolic or salicylic acid or thymol. The object of such additions is to prevent fungoid growths in the fluid after mounting. We have entirely discarded the use of such agents in

mounting small objects in cells, partly because some of them, particularly salicylic acid, cause a rapid change of color of such preparations as algæ, but mainly because they are not necessary as preservatives. Water alone is quite sufficient, probably because it takes up sufficient alcohol or other substance from the cement used in attaching the cover-glass to prevent any growth within the cell.

We will now proceed to give a general description of the processes of mounting in a cell in fluid, and although it has been quite commonly supposed that fluid mounts are not durable owing to the difficulty of sealing them, we hazard the assertion that those who will follow the directions here given will never be troubled with imperfect cells. These directions must be followed in every detail or we cannot guarantee good results. For convenience we number the operations in order.

**MOUNTING IN AQUEOUS FLUIDS AND GLYCERIN.**—1. Prepare a number of slides with cells of thick shellac of the proper depth for the specimens, and let the shellac be thoroughly hard before mounting. The best method of preparing deep cement cells is to use the shellac as thick as it will readily flow from the brush, and run a rather heavy ring on the slide in the usual way, making the inside diameter the exact size desired for the finished ring. Then running the turn-table rapidly, apply the point of a knife-blade to the outside of the circle and slowly move it inwards, thus turning up the cement and increasing the thickness of the ring. With a very little practice cement cells can be made a sixteenth or a tenth of an inch deep in this way, and very rapidly. Have the objects ready, in the medium in which they are to be mounted, and then prepare the hardened cells as follows:—

2. Selecting a clean cover-glass, run a coating of Canada balsam in benzole with a brush on the top of the cement-cell, being careful to cover

it well with the balsam in such a way that the cover-glass when applied will sink down upon the balsam and effectually close the cell.

3. Before the balsam has time to harden, fill the cell with the mounting fluid, transfer the object to it, arrange the specimen with care, and immediately apply the cover-glass. If the object be one that is easily disarranged, it will require considerable skill to apply the cover without disturbing it. This, however, must be left to the ingenuity and skill of the preparer, as it is impossible to give directions that will immediately impart skill that only practice can give. It may be said, as an indication of the manner of putting on the cover-glass, that the cover should be held in forceps in the right hand while a needle in the left will serve to direct it to the proper place on the cell. One edge of the cover is placed on the cell against the needle point, which prevents it from slipping, and the other side is then gradually lowered, driving out the superfluous fluid beneath it, until it rests in position. In doing this, breathe upon the cover, so that the moisture of the breath may condense upon the under surface. This causes the fluid to come readily in contact with the cover, and prevents the inclusion of bubbles of air. Then gentle pressure is applied around the edges to ensure perfect contact, and the superfluous fluid is removed from the slide with blotting-paper, except when the fluid is glycerin, in which case it is generally advisable to postpone any cleaning until the balsam dries.

The balsam cements the cover to the cell, and if the sealing up to this point is perfect the fluid will keep for any length of time, so long as the slide is not roughly handled. To ensure against any possible defect in this respect, as soon as the balsam is hard the slide is carefully dried, first washing off every trace of glycerin with water and a soft brush.

4. A second coat of the balsam so-



lution is now applied, to guard against any defect in the first application. This should run just over the edge of the cover-glass. A careful examination of the cell will show whether the last coat of balsam is perfect or not. It must be continuous around the cover-glass, and if there are any breaks in it they must be remedied. Breaks may occur if the mounting fluid is not entirely washed off from the outside of the cell. This is especially the case when glycerin is used. A good way to do the washing is by holding the slide under a tap of running water and using a soft brush. A convenient method is to use a chemist's wash-bottle to direct a stream of water upon the slide. This is the method employed by the writer in preference to any other.

The only modification of the process, as thus far described, that can be sanctioned by experience, is the substitution of thin shellac for the balsam to cement the cover down. Shellac may be used for this purpose, and it serves just as well—possibly it is even better when glycerin is the mounting fluid. The operations are precisely the same as when balsam is used.

5. The fluid is now perfectly well secured, so long as the slide is not handled carelessly. The mounting is, in fact, done, so far as the mere preservation of the specimen is concerned. The slides may be kept for years in the cabinet without further treatment. However, the cement holding the covers is very thin, and as balsam becomes brittle after awhile the covers would be likely to come off by rough usage. They should, therefore, be secured by a protective cement, and it is our custom to set them aside in the condition just described until a number have been prepared, when they are all rapidly carried through the finishing process together.

The protective cement in most favor with us is the mixture of equal parts of asphalt or Brunswick black

and gold size. This is applied in two or three coats, each being allowed to dry separately, until the cover is well secured.

6. The final operation is the finishing, which is merely the application of a coating of asphalt or Brunswick black alone, to give a fine black polish to the cell.

Having given this method of mounting in detail, we repeat that if the instructions are carried out the mounts will never fail. We trust that the method will be adopted by many persons who have used balsam hitherto, under the impression that fluid preparations could not be relied upon. As thus prepared they are sure to stand, as the experience of years has shown.

—o—

### Sand.\*

BY J. G. WALLER.

A grain of sand is one of the smallest of visible atoms, and as such passes into the language of metaphor. The aggregation of sand, as a symbol of untold multitude, is probably familiar to every language upon earth. In the operations of nature, working about us, we are ever being astonished at the minuteness of an individual agent towards the mighty end. So it is with sand, not only as it is working now, but as it has worked in inimitable ages past. The attrition of hard particles—silex—whether produced by storm floods, river torrents, or the tempestuous waves of the ocean, plays a part in its production, blocking up estuaries, and forming at the mouths of rivers dangerous shoals. This is mostly shown by those grand rivers of the earth draining large continents, and not tidal. But at the mouth of our own Thames, which is tidal, and a mere pigmy in comparison, we have large sandy deposits,

\* Although this article was published two years ago, our attention has only recently been especially drawn to it through some examinations of sand of our own coasts that have been made of late, but not yet published. The article seems worthy of republication even at this late date. It is from the *Journ. Quekett Micr. Club.*—Ed.

often fatal to the mariner. Thrice has our great poet named the 'Goodwins,' and in 'The Merchant of Venice' it is spoken of as 'a very dangerous flat and fatal, where the carcasses of many a tall ship lie buried.'

Then there are the vast sandy deserts, like dry oceans, also disturbed with moving waves and storms, overwhelming whole caravans of merchants or of pilgrims, who leave behind them a trail of whitened bones. Besides which it has its floods, as we call those moving sands lifted by the wind, and which in Egypt have encroached upon that fertile oasis, burying many of its ancient and renowned cities, whose monuments would seem almost to defy the hand of time. Nor are we without these phenomena in our own country, as the entombed church of Piranzabuloe, in Cornwall, testifies. But one of the most remarkable of these sand floods occurred in 1688, on the borders of Suffolk and Norfolk, and which is fully described by a gentleman named Wright, a great sufferer by its destructive influence, in the early numbers of the Philosophical Transactions of the Royal Society. It is too long to insert here in full. I will therefore briefly give you some of the facts. It began at the small town of Lakenheath, where some sand-hills, covered with scanty herbage, got denuded of this by the wind blowing tempestuously from the southwest. These sands, lying on the chalk, belong, as I believe, to the series called by geologists the 'Thanet sands.' At first, about ten acres of ground got covered, but before the flood had advanced four miles it had overwhelmed one thousand. This visitation continued for many years, in spite of all attempts to arrest its progress. After twelve years had passed away, its first real obstacle was descending a valley, but it then ascended the opposite hill, entered the town of Downham, destroying several houses. The house of the narrator was almost buried in sand, which had mounted

up to the very eaves of his outhouses. It partially filled the little river Ouse, and interfered with its navigation; and it was only conquered by years of sedulous care and enormous labor.

But it is in the formation of this earth's crust that the mighty power of sand is shown in enormous sedimentary deposits, the Old Red itself being estimated at 10,000 feet in thickness, added to which are others still earlier, and many that carry us upwards to the Tertiary system, where I propose particularly to enter and discuss our subject. What is this sand, so ubiquitous, so vast in its aggregations? A writer on 'Beach Pebbles' put the question to a traveller from the great desert, in respect to which he answered, 'Powdered quartz.'

But it is the sand of our coasts in which the special problem for discussion lays, and more particularly that on our eastern and southern shores, where are beaches of shingle fed from the debris of the upper chalk.

If we take a diagonal line from the estuary of the Exe to the Humber, east of it lays the large chalk formation of England. Sometimes it shows itself in rearing lofty white cliffs, by which our country obtained the name of 'Albion;' at others it is only known by its ruins, and these have an extensive admixture of other deposits. Nevertheless, its bones, it may be said, are everywhere left behind in the dense flint shingle. These beaches are often many square miles in extent, shutting up ancient estuaries, which are known to have been navigable in historic times. But besides these accumulations by the seashore, we are well familiar in the great London basin of deposits of this same shingle with intercalated layers of sand, and the gravel, with its ferruginous hue, known to all for its use in our garden walks. This last, the most superficial of such deposits, caps the London clay over a large part of the metropolitan area. There is another earlier, known as the Bagshot



sands, of which Hampstead Heath gives us an example easy for examination. Proceeding downwards, we pass through the vast mass of the London clay, and come to the Pebble bed, well represented at Blackheath, and well named for its small rounded pebbles, like marbles of various sizes, and mixed with this is sand. All these pebbles are of chalk flint. Deposits, more or less mixed with sand, succeed these, until we arrive at the 'Thanet sands,' laying on the chalk. Of what material, then, are all these sands, and wherein derived is the question proposed to this Society.

Of course the *prima facie* view is that they naturally arise from the attrition of the flint. Nothing is more apparently obvious. Away from the region of the chalk flint, our coast sand is mostly composed, as we might imagine, of the débris of the adjacent cliffs or rocks, or from other prolific but neighboring sources of supply, such as shells of molluscs, or calcareous particles of the remains of various zoophytes, as, for instance, at Land's End, and other parts of Cornwall. After we pass westward of the estuary of the Exe, chalk flint is of rare occurrence on our coasts, although an outlier of the chalk débris may be seen west of but close to the Teign.

Now then we will proceed to see how far this question belongs to us as a Microscopical Society. Let us take a pinch of sand out of a washing down of a road paved with gravel, after storms of rain, and submit the same to the microscope; or, to be certain in our experiments, let us pound up some chalk flint finely. Our examination of it will show us that the flint has a granular appearance, and does not polarize.\* Let us now take a piece of quartz and reduce it to powder, and submit this to the microscope, and we find it to be translucent and clear, and it polarizes brilliantly. Moreover, the frac-

ture of the quartz is different from that of the flint. These conditions understood, we are now prepared for the problem to be solved, one which belongs to the geologist, if not to the physicist.

Our eastern counties have beaches of chalk shingle and sand, and the cliffs are mainly a tertiary deposit, consisting of clays, sands, and flint gravel. These counties are devoid of building stone, so all their ancient churches are built of flint, and much ingenious workmanship is therein shown. Little stone is seen but that which belongs to the upper greensand, locally known as 'clunch,' sometimes oolite in small quantities, which must have been brought round by sea, and occasionally sandstone, which, belonging to the Wealden system, could not have been obtained nearer than Hastings. Consequently there is no material whatever on the coast capable of furnishing any quartz sand. Still one must always remember that the operations of nature are large, and our views of them small. The visitor to Yarmouth must remark the deep sand deposits on its shore. Let us cross to the other side of the German Ocean, and large dunes or hills of sand are found all around the coasts of Belgium, leading into France as far as Boulogne. Does it come from chalk flint?

I have examined sand from Lowes-toft, and I find it all to be of quartz; in a slide made from its sand only one piece of chalk flint is seen. Dr. Matthews gave me some sand from Aberdovey, Wales; it is mostly of quartz, with some intrusions of other substances, but none, of course, of chalk flint. Indeed, no one could discover any difference between the two, although one is on the eastern side of our island, amid nothing but chalk débris, whilst the other is on the western side, in the Irish Channel, where no chalk or chalk flint exists at all. Let us travel higher up our eastern coasts as far as Yorkshire, and at Bridlington the sand is again

\* It would be more correct, perhaps, to say that it does not give any prismatic colors.

quartz; in a slide made of it the few intrusions of flint are about three or four.

Let us now come back to our southern coast, and one of the facts that first attracted me in relation to this subject was that organisms using sand for building purposes always choose quartz. It is so with that curious spore *Dysidea fragilis*; it is so also with the ovisacs of one of the mollusca, which at first look so much like a sponge. These are completely built up of quartz sand, and although other fragments are sometimes used, and even foraminifera, yet it is rare to find anything of chalk flint. *Dysidea* is common at Brighton, where the shingle is of chalk flint, and one might think sand also; but it is quartz that is used.

What then becomes of the flint sand? We see the rounded pebbles: abrasion must produce powder, *i. e.*, sand. What then can become of it? Does the flint change to quartz? Is it possible that any molecular metamorphosis can take place, or, if not, what becomes of the abraded dust of chalk shingle that it is always found in such small quantities? Then whence proceeds this very abundant and ubiquitous quartz sand? The set of the current of the English Channel is, I believe, from west to east; that of the German Ocean from north to south.

We must think of all the conditions existing to account for the prevalence of quartzose sand. On our southern coast there is a large gap between the chalk cliffs of Dover and that of Beachy Head, in which the Wealden deposits make their appearance, consisting of sandstone grit, shaley laminated sand rock, and the like—all of fluvial origin—remains of the delta of a mighty river, equal, at least, to that of the Ganges. This sand is of pure quartz, or nearly so, and as the Wealden outcrop crosses the English Channel, though not represented on the opposite shore, here is necessarily an abundant supply of quartzose sand.

Still we must note that the coasts, all along this gap, have the usual beach of chalk flint shingle. Indeed, it is represented in enormous quantities, often a mile and more in diameter at the closed-up ancient estuaries referred to. First, there is that of Pevensey, where the old Roman castrum is in a more complete condition than is found elsewhere, and which once defended its entry against our ancestors the Saxon pirates. Let us be proud of our Saxon forefathers, of whom the Roman historian pitifully says, 'Præ ceteris hostibus Saxones timentur.' Then let us go to Romney Marsh, where is the same phenomenon on a grand scale, and another ancient estuary closed up, the 'Portus Lemani' its fortress, which once defended it, a shapeless, disrupted ruin. Here the rolled shingle covers many a square mile. Where then is the detritus of all this mass, if it is not found in the sands adjacent?

There is still to be brought into the account the upper and lower greensand, the Shanklin sand which must furnish a part of the ocean bed as it crops up by Folkestone at Copt Point. But we have to consider whence these are derived. The more we seem to go into the matter the more intricate or extended does the problem appear; and yet its solution ought to be within a small circle, for what we are seeking to know is, what becomes of the detritus of chalk flint?

Let us now proceed to examine the geological deposits of the tertiary period, formed within the large depression scooped out of the chalk, called the London basin. And we will take them in order, and first the brownish loam or brick earth, which is abundant about and in London. Washing a portion of this, taken from the neighborhood of Hampstead, after getting rid of extraneous matter, there remains a portion of sand, which appears to be in part or wholly of quartz, though much comminuted. Amongst it, however, are some, though few,



intrusions of chalk flint. The main fact is the general quartzose character of the whole.

Next in order comes our familiar gravel, with its sand layers of that deep ferruginous hue, prized for our garden walks. Of this I took samples from a section on Epping Forest, near Loughton, made for a supply of fine gravel. Here, one would have thought, if anywhere, being in the midst of a chalk flint débris, rolled together to all sizes, that a vein of sand must show the same form of silex. My specimen was taken four feet from the capping of loam, firmly compacted together, and of a deep rusty color. On submitting a slide made from this to the microscope by polarized light, I was astonished to find it so unpromising of quartz. There were other substances, yet extremely few in number, and I am not able to pronounce upon them, but not the smallest atom of our familiar flint of which every pebble around was composed. But not satisfied with one specimen of the sand, I took another from a vein of a pale gray tint close by, and the same results ensued, as indeed one might have expected, only in such investigations one should never assume anything, but resort to experiment.

We now come to the series of the Bagshot sands, to which I have alluded, and testing a specimen from Hampstead Heath, after washing it, quartz is found to be the largest basis of the deposit. Other particles, however, are seen in it, some of which look like amber, and some fragments remind one of the color of the Cairngorm, yet it requires a mineralogist to pronounce upon them. The character is also special in the presence of dark specks and nearly black bodies, and we must certainly seek in another direction than flint shingle, of which few signs are to be seen, as the factor of the Bagshot sands.

The vast mass of the London clay, that deposit of estuary mud of a tropical sea, has its layers of sand represented at White Cliff and Alum Bays,

Isle of Wight, and of these I have examined several specimens, representing upper, middle, and lower beds, as well as other series, but they all declare the same general facts, quartzose sand, with few intrusions of flint, more or less comminuted. So we will take into consideration the layer styled 'Pebble bed,' where the flint is rolled into marbles of various sizes, intermingled with and embedded in sand. Here, if anywhere, one would expect to meet with atoms of flint in abundance. But the examination of the fine sand of the bed referred to shows the same result, and it suggests to us that flint abrasion produces very small and thin flakes which easily break up and disappear into very minute parts, but that the harder quartz, never taking the same form of fracture, is a more enduring form of silex. So that the one disappears rapidly, whilst the other continues an almost indefinite time. This is the only way I can account for a phenomenon so apparently singular; but I am open to the conviction of a better solution if that can be given. The result, then, is remarkable in the all but absent flint particles. These are, indeed, represented, but they are few in number in comparison with those of the quartz. There are other substances than this; but, as before, it is the predominant form, although in the midst of rolled flints. The sand is very fine in character, the particles of quartz very small, resembling those of the brick clay.

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We now come to the chalk from whose upper series our vast deposits of flint shingle must have been derived by the extensive denudation and destruction to which it has been subjected. Belonging, geologically speaking, to this series are two layers entitled 'the Upper and Lower Greensand,' separated from each other by the Gault Clay. The Upper Greensand is best known to us by the limestone, called familiarly clunch, firestone, hearthstone, used extensively

in the Middle Ages as a building stone, the palace and Abbey of Westminster having been mainly constructed of it from the quarries of Merstham, though passing under the general term of 'Ryegate Stone.' It was also used for effigies, and for indoor purposes; kept free from damp, it was durable, and preserved a sharp edge in its working. Dissolving the lime from it, the deposit shows us nearly half to be finely comminuted quartz, some few particles of flint equally fine, and a large quantity of silicified casts of many species of foraminifera, and particularly of one very minute in size, which I assume to belong to the Globiogerinae. Other forms I am not acquainted with, look like portions of very minute encrinurites, but I must profess my ignorance; and as the subject has been worked out by Ehrenberg, I suppose it is well understood. I may remark, however, that these silicifications have in composition a remarkable resemblance to that of chalk flint, which would rather support the view of Mr. Hawkins Johnson, that the latter was of organic origin. As a factor of the sand of our coasts, this deposit could play but a small part, and may therefore be dismissed for the consideration of the lower bed.

This bed is known as the 'Shanklin' Sand, from its being so well represented in that locality, and has at its base a well-known building stone called 'Kentish Rag.' Taking some seams of sand found with it for examination, I find one-half to be composed of quartz, the other of dark opaque grains, which I cannot identify. I have examined also other specimens from different beds, but the result is the same.

I will now, in conclusion, take a retrospective glance at the facts presented before you. The one great fact is the predominance of quartz. It is only in the two lower beds, 'the Green Sand,' that this material is not in excess of every other, and even in them it constitutes one-half, and in

neither case does the chalk flint appear but in very small quantities. That it should be almost absent in the gravel composed of flint shingle, and from sand veins found in the very midst of its rolled pebbles, is very surprising. The quartz sand, of the gravel, has larger grains by three or four diameters than in any other locality named, and has many points of interest to study. It is well rounded by attrition, which is not the character seen in many other examples. It seems to be often in a state of apparent decomposition, and is covered by an oxide of iron, which requires to be removed by acid for its more complete examination. In the Bagshot Sands we should scarcely have expected to find chalk flint grains, but they appear in the proportion of 4 to 7 per cent., and in this deposit the quartz has some rounding of the edges, but not giving a character to the whole. Nevertheless, it more resembles that of the superficial gravel.

I alluded, at the commencement of my paper, to the sand found at Bridlington, and particularly that at Lowestoft, on account of the comparison instituted between it and that of Aberdovey. But it would be a very imperfect argument, after so many specimens from ancient deposits, not to notice some of those now forming. By the kindness of Mr. Priest, I have been enabled to examine examples of the sands of Cromer and those of Ramsgate. They are composed of fine examples of rounded quartz particles, with chalcedony and a few other substances, some of calcareous origin. That at Cromer is resplendent in its quartz, when beneath the microscope, and is, perhaps, the finest of all my examples, extremely beautiful as an object by polarized light, and, I think, instructive in its illustration, could one pursue the question further than at present I propose to do. From Hythe, in Kent, I had some sent up to me from high-water mark, thinking it might there be more free from the engrossing quartz. But



no, the result is the same as in the previous cases, but these last examples all declare in the flint particles present, flakes unrounded in opposition to the rounded quartz, that the last is ancient, produced by the attrition, perhaps of ages, whilst the other is modern and recent. This evidence is remarkable, as it declares an important fact in our inquiry, which points to the one as ephemeral, to the other as of an unknown duration, perhaps dating its origin from the primitive rocks.

From Dymchurch, in Romney Marsh, where the flint shingle is seen extending for miles up to the point of Dungeness, and always increasing, the sands reveal the same oft-repeated tale—quartz, with an almost entire absence of flint particles.

I do not here pretend to show whence proceeds this abundant supply of quartzose sand all around our coasts. It is a matter for further inquiry and investigation, but one must suggest the probability of it being, in part at least, brought down by rivers. And this will at once lead us to consider whether that noble stream, the Rhine, may not be one of the factors of supply. Descending from the Alps in a strong and powerful current, generally turbid, but particularly so after a season of storms on the breaking up of winter, it has for ages poured forth its waters into the German Ocean. I know nothing more imposing than the scene presented, when looking down from the hills beyond Bonn upon the vast delta before you. It is as level as the sea, and far on the horizon the city of Cologne is detected only by the lofty towers of its cathedral, as if a ship riding on the ocean. Its many mouths must each send forth, mixed with its strong current—for it is not tidal—a mass of sand, represented doubtless by the dunes of Holland and Belgium, which have been planted with *Equisetum* to tie together its instable substance. The Alpine loess of Belgium is itself largely commingled with quartzose sand of

similar origin, making a large source of supply.

Amongst other materials than quartz referred to, chalcedony is the most common; there is also a kind of conglomerate, of minute parts, which polarize vividly, some fragments homogeneous in color, being of a neutral gray, as well as some other substance less easy to describe, whilst in some few cases there are pieces evidently from granitic rock. Flint, when seen under polarized light, does not exhibit color, but nevertheless its character is thus best distinguished. Occasionally I have imagined I have seen some instances in which a change has been undergone. I speak of this doubtfully, but certainly there is nothing which has the slightest approach to a metamorphosis into quartz. It has been supposed by some that an infiltration of chalcedony does take place occasionally, but that must surely be, if at all, before the formation of sand particles. An old French writer, M. Reaumur, in *Mémoires de l'Académie des Sciences*, 1721, writes: 'By a coarse operation emery is reduced to powder, and suspended in water several days; but nature may go much further than this, for the particles which water detaches from hard stones by simple attrition are of an almost inconceivable degree of fineness. Water thus impregnated contributes to the formation of pebbles by petrifying the stone, as it were, a second time. Stones already formed, but having as yet a spongy texture, acquire a flinty hardness by impregnation with this crystalline fluid.'

I state this as I find it. The author gives no facts, so the hypothesis must stand by itself. But there is one point worthy of note, wherein he speaks of the extremely minute particles produced by mere attrition. This in rounded pebbles must indeed be infinitesimal, and one could hardly expect to find such particles of any moment in the composition of sand. But it must be otherwise with the rough flint, as it comes from the

chalk, and doubtless such sand particles of this material which are found are thus produced before the pebble is softened into a rounded form.

It would certainly be plausible, as has been suggested, that a molecular change may take place in flint during the lapse of ages, difference of temperature, and the like. But the fact that flint particles do appear, although in small quantities, in ancient deposits, exactly the same as you may now artificially produce them, deprives us of the use of such an argument. Its great scarcity, as I have shown you, almost seems illogical, but the sternness of our facts makes us accept them whether we like it or not, and we must endeavor to explain this phenomenon by the same logic of facts. But the ubiquity of quartz sand is not confined to our coast. In examining some organisms from South Australia, containing sandy particles, some also from Mauritius, Madagascar, and Algoa Bay, the same facts are shown. There are not only the common quartz grains, but other materials, such as are visible among the sandy deposits I have described, and seen in about the same proportion. This is interesting, as declaring one universal source, whether in the northern or southern hemisphere, and helps in the illustration, if not in the solution, of the question before us.

I must confess to ignorance of many points of detail suggested in this inquiry, but as we are composed of many active units, let us take a moral from a grain of sand, one of the smallest of atoms, yet in its aggregate playing so great a part in this earth's crust. Let, then, the aggregation of our Society's units make a large addition to our scientific knowledge; the subject before you has yet many lapses, and I trust these may be filled up by your active researches.

—Considerable interest has been aroused of late by Prof. T. Bolton's studies of musical sands. They are found on every coast, although until recently supposed to be of rare occurrence.

## EDITORIAL.

**Publisher's Notices.**—All communications, remittances, exchanges, etc., should be addressed to the Editor, P. O. Box 630, Washington, D. C.

Remittances should be made by postal notes, money orders, or by money sent in registered letters. Drafts should be made payable in Washington, New York, Boston, or Philadelphia.

Subscription-price before April 1st, \$1 per year, in advance. All subscriptions after this month begin with the January number. After April 1st the subscription-price will be \$1.50.

The regular receipt of the JOURNAL will be an acknowledgment of payment.

**AMERICAN ASSOCIATION.**—The circulars of the Local Committee have been issued, and contain much information about the meeting. Although there are no announcements for the section of Histology and Microscopy we can assure the reader that there are some valuable papers to be presented. Persons intending to be present at the meeting should obtain the circulars, which they may do by writing to the Local Secretaries at the Academy of Natural Sciences, Philadelphia. Railroad fares from Philadelphia to Montreal and return are reduced to \$15.50 for members of the Association, and generally members will be able to attend the meeting and return to their homes for the price of a ticket one way.

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**AMERICAN RECOGNITION OF AMERICAN SCIENTIFIC WORK.**—Not long ago\* we had occasion to allude to an article in the *Scientific American* in which the unjust assertion was made that no work was in progress in this country upon the micro-organisms of disease—that the scientific value of such work was not recognized here. If such assertions are worthy of attention in the *Scientific American*, a paper which, while occupying a wide and useful field, is by no means, either in fact or pretension, an exponent of the scientific work of the country, it is impossible to pass unnoticed an equally unjust, and far more important, declaration of the same kind in a paper which purports

\*Current volume, p. 55.



to be the great representative of American science.

In the number of *Science* of July 28th we find the following expressions: 'Work of value upon the subject of micro-organisms is not done in this country.' 'Until \* \* \* we can hope for no better work in the future than has been done in the past.' In regard to the first assertion it is essentially untrue. In regard to the second, it is doubtful if any better or more thorough work will be done under more favorable conditions than has already been done here. It is true our Government does not encourage such researches as it should; it is true better facilities for it should be offered by Government departments. One might justly infer, from the tone of articles that have appeared from time to time in *Science*, that there is some spite on the part of the writers against Government departments. Surely *Science* should be above such influences, and we sincerely trust it is. Yet the fact remains that *Science* is continually finding fault with what is done in such departments. Granting the disadvantages under most scientific work under Government is conducted, all the more credit is due to those earnest investigators who accomplish good results under the trying circumstances. Such work deserves recognition. The Editor of *Science* cannot be ignorant of what has been done in the particular field of work above mentioned, as the columns of his paper show; and the writer of the article in question should not have made such a bold assertion without some knowledge of the facts. Even a specialist would be scarcely justified in such a sweeping condemnation of American work.

The injustice of such assertions must be discouraging to investigators here. It is clear evidence that their work is ignored by the paper which should be the first to recognize it. Compare the article from which we have quoted with another on the same page,

in which we read: 'So far as Koch's work upon tuberculosis is concerned, it remains a complete monument of scientific accuracy. \* \* \* We are bound to consider that the cause of tuberculosis is found \* \* \* in the bacillus of Koch, to whom all honor is due for the beauty and completeness of his investigations.' Let us have some such recognition as that of home work from the same source. It will encourage our own observers to further effort. The merit of Koch's work is unquestioned; but the best informed would scarcely venture to go quite so far as the author of the above lines in declaring the direct connection between the bacillus and the disease. Yet the praise is unstinted. 'Can any good come out of Nazareth'—which is a U. S. Government department?

We have asserted that good work, thorough work, has been done here and is still in progress. It is not necessary to refer to it in detail. It is not the purpose of this article to do so. The principle at stake is what now concerns us, and concerns every scientific man in the country. In behalf of such men, and there are many, we protest against the attitude of *Science*, as indicated by the quotations we have made. It is not a question of policy or good taste on the part of the conductors of what should be an authoritative and trusted scientific paper; it is a matter of justice. Our scientific observers have a right to demand adequate recognition in the columns of *Science*, or at least that their work shall not be belittled and ignored, no matter in what field they may be engaged. They have a right to demand that criticisms in that paper be written without bias, and by persons who are familiar with the subjects they treat. Such an unjust and unnecessary assertion as we have quoted must seem hard to one worker whom we might name, who is conducting his investigations at his own expense, and at such sacrifices as only an earnest and careful worker would

be willing to make—certainly not the writer of that paragraph, for the thoroughly earnest worker is never hasty to criticise the labor of his fellows.

If *Science* did not hold itself so far above some of its less pretentious contemporaries, in their more limited and avowedly less profound departments of scientific research, it would doubtless find information that would prevent statements so injurious to the prospects and discouraging to the promoters of American scientific work in their special departments.

Upon microscopical subjects, this JOURNAL, in spite of its unpretentious size and character, possesses some claim to recognition even from its superiors in other fields, and however humble it may be in the eyes of those who despise 'microscopists' as a class of unscientific amateur observers, certain it is that no reader of this JOURNAL would have made the bold assertion quoted above, or allowed it to pass unchallenged.

May we not look in future with more confidence to a fair recognition of American scientific work in the columns of *Science*, and trust that the writers of reviews and criticisms will hereafter not fail to recognize the claims of their own countrymen.

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POSTAL CLUB BOXES.—Our remarks of two months ago concerning the operations of the postal club have met with a rejoinder from one of the officers that is very satisfactory to us. He writes what we can well believe: 'I assure you that the work done is quite equal to that needed to run an extensive and profitable business. \* \* \* Your remarks are timely. \* \* \* There are some who must go—they don't help with their contributions, they obstruct the workings of the club by their disregard of the rules, etc.'

Box E reached us June 25th, containing five slides, No. 3 missing:—

1. *Pleurosigma angulatum*. L. H. Noe. Mounted in mono-bromide of naphthalim, with index of refrac-

tion 1.658. 'A one-half inch of maximum angle of 65°, made fifteen years ago, will show the striæ, and a one-quarter inch, 135° dry, shows them with the A eye-piece power 240 or less.'

2. *Spongilla*, a Fresh-water Sponge found in a small pond in the White Mountains. Samuel Lockwood. An excellent description is appended. Such preparations and explanations are just what the club needs. The mount has been damaged and repaired twice, but still enough of the sponge remains for examination.

4. Section of Tongue of an Infant showing Striated Muscular Fibre. R. H. Chase. A very fair section and an attractive object, without any description.

5. Section of Small Intestine of Kitten, showing Muscular Structure. Amos Seip. Sections not very perfect, and no description.

6. Fungus found on the Upper Surface of May-apple Leaves. Eugene A. Rau. The fungus is *Æcidium podophylli*. This also is a well-described preparation, as well as a good one for examination.

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## NOTES.

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—The following notice from Prof. J. C. Arthur deserves attention:—

'Microscopists who make botanical observations should bear in mind that the meetings of the Botanical Club of the A. A. S. offer an admirable opportunity for presentation of short papers, isolated observations, and the discussion of minor topics which may not be sufficiently weighty to be brought before the biological section of the Association. The meetings are open to all interested in botany. The place and time for each day will be given upon the daily programme of the Association.'

—Microscopists will regret to learn that owing to failing health Mr. L. R. Sexton has been obliged to give up business. Mr. Sexton has been favorably known to microscopists for a number of years, and has sold many of the productions of the well-known optician, E. Gundlach. For some time his health has been failing, and



at the beginning of this year he was doubtful of his ability to carry on his business long. We regret to learn that necessity has compelled him to make the sacrifice of his business; but it has gone into good hands, and will hereafter be conducted by the Bausch & Lomb Optical Company.

—Mr. A. W. Bennett has investigated the reproduction of *zygnemaceæ*, and finds that there are indications of a sexual character in the conjugating cells, the female cells being the larger in diameter and length. The cell-contents in conjugation always pass in the same direction. These observations can be submitted to critical examination by any person with a good microscope and eye-piece micrometer, and we commend them as worthy of attention.

—Mr. G. B. Buckton, author of a 'Monograph of the British aphides,' describes a method of mounting aphides which may doubtless be advantageously applied in mounting small insects. It is given as follows in the *Journ. R. Micr. Soc.*:—

'Five or a dozen spots of fluid Canada balsam should be dotted on a slide from the head of a pin, and by means of a hair-pencil as many living insects transferred to them. "The specimens at once adhere, and if the spots are small the insects spread out their limbs naturally, with a view to escape. They may be fixed on their backs or otherwise, according to the views desired."

'A very thin glass cover, or, if very high magnifying powers are wanted, a small disk of clear mica, is laid over the insects, and then one or more drops of the fluid balsam are delivered from a glass rod at one of the sides of these covers. The balsam runs slowly under by capillarity, and it drives all the air before it, the small weight of the cover assisting it to spread, until the whole area is filled.'

\* \* \* 'To spread the wings of a small insect, the above-mentioned small dots may be made in a row. The belly of the specimen is applied to the middle spot, and by a bristle one wing may be applied to the dot on the one side and the other wing to the third dot.'

—We are requested to give place to the following notice:—

'At the meeting of the American Medical Association held at Washington in May last, an Amendment to Regulation ii was adopted, which provides that—

"Membership in the Association shall be obtainable by any member of a State or County Medical Society recognized by

the Association, upon application endorsed by the President and Secretary of said Society; and shall be retained so long as he shall remain in good standing in his local Society, and shall pay his annual dues to the Association."

'Applications for membership, in the manner specified above, accompanied with FIVE DOLLARS for annual dues, should be sent directly to the Treasurer, Dr. Richard J. Dunglison, Lock Box 1274, Philadelphia, Pa., on receipt of which the weekly Journal of the Association will be forwarded for one year to such member.

'WILLIAM B. ATKINSON, M. D.,

'Permanent Secretary.'

—It will be seen from our advertising columns that Dr. H. H. Chase not only sells some good objectives, but also now offers some test objects for them, mounted in a medium having an index of refraction of 2.42. This should soon settle the question of the dotted appearance of *Amphipleura pellucida*.

—Scarcely do we hear of Mr. Sexton's retirement from the microscope business than Mr. E. Gundlach sends us a circular announcing a new business connection, whereby he will be enabled to continue the manufacture of objectives. He promises 'first class and strictly uniform work at reasonable prices.' We wish him the success he merits. A new priced catalogue has been issued by the Gundlach Optical Co., of Rochester.

—An Allegheny physician, having his suspicions aroused that there was some trick about the living things found in the water on the South Side when examined under a microscope, found that a peddler of microscopes had led to all the trouble. The attention of Dr. Shillito, of Allegheny, was called to the matter. Dr. Shillito possesses one of the finest microscopes in the country, and is an expert in all microscopical matters. He examined one of the peddler's plates and found that the 'wrigglers' were what are known as sour-paste lizards. These creatures, invisible to the naked eye, are generated by sour-paste. The paste can be dried and kept for years. A drop of water will dissolve it and reanimate the thousands of lizards that it contains. The peddler was hunted up and forced to divulge his secret. He had in his vest pocket a small bottle filled with sour paste in liquid form. On entering an office he would offer to show the impurities in a drop of water. The drop would be brought to him on his glass plate. In the most natural manner pos-

sible he would draw his toothpick, which was sticking in the invisible bottle, and spread the water over the surface of the glass. Just enough of the sour paste adhered to the toothpick and was deposited on the glass to carry a number of the lizards with it. The glass, so prepared, would be placed under the magnifier, and the water would be found to be alive with transparent lizards that seemed never tired of flashing back and forth under the glass. Dr. Shillito exposed the trick to a number of friends last evening, after having successfully made them believe that it was the water alone that they were examining.—*Newspaper*.

—We learn from a letter of Mr. E. C. Bousfield to *Science Gossip* that at some future time there is likely to be published a monograph on rotifers by Dr. Hudson, many fine drawings for which are ready. The same writer mentions the fact that the male of the common *Rotifer vulgaris* has not yet been described, and of about two hundred known species at least seventy per cent. of the males have yet to be found.

—The Alumni Association of Jefferson Medical College has inaugurated a movement to secure, in some medical school, the endowment of a memorial professorship, to be designated the S. D. Gross Professorship of Pathological Anatomy.

'The profession at large, the personal friends of the late Professor Gross, and others interested in elevating the standard of medical education, are cordially invited by the undersigned to participate in this graceful recognition of conduct and services which have largely helped to establish the high standard of excellence to which surgery has attained throughout the United States, and served so much to dignify the repute of American medicine.'

Contributions may be sent to Dr. R. J. Dunglison, treasurer, lock box 1274 Philadelphia P. O., and will be acknowledged in the columns of the *Medical News* of Philadelphia.

## NOTICES OF BOOKS.

*The Course and Growth of the Fibro-vascular Bundles in Palms.* By John Casper Branner, B. S. (Pamphlet, pp. 24.)

The substance of this pamphlet was read before the American Philosophical Society in October, last year. The author begins with a reference to the unsatisfactory character of the work of early botanists relative to the peculiarities of endoge-

nous growth, based upon the supposed course of development of the fibro-vascular bundles of the palms. The difficulties in the way of thorough investigation are stated, and the literature of the subject briefly reviewed. The theories of the principal observers are concisely stated and followed by the author's own observations, which have led to important conclusions. It is not possible to do justice to this small but concisely written and illustrated pamphlet, which is of great interest to microscopists as well as botanists, in this place.

The subject is worthy of a careful review, which will be prepared in future for this JOURNAL.

*Fibrine and Bacteria.* By Thos. Taylor, M. D., microscopist, Washington, D. C. (Pamphlet, pp. 5.)

This is a reply to the statements of one Dr. R. R. Gregg, whose observations upon this subject have been severely criticised by a writer in these columns. The subject is scarcely worthy the attention it has received.

## Exchanges.

Exchanges are inserted in this column without charge. [They will be strictly limited to mounted objects, and material for mounting.]

Echinus spines of various species offered to any person who will send in return three good sections of the same.

Box 630, Washington, D. C.

Wanted—Diatoms on seaweeds and in muds, from all the tropic seas. Offered a large quantity of fine selected diatoms and other slides, or cash.

J. C. RINNBOCK,  
14 Simmering, Wien, Austria.

Will exchange well mounted slides for others well mounted.

H. H. PEASE,  
1271 Broadway, N. Y.

Living red *Astasia nematodes* (*Euglena viridis*) and *Volvox* sent on application, or mounts of the same in exchange for algæ, fungi, or infusoria.

J. M. ADAMS,  
Watertown, N. Y.

Material for mounting of all kinds wanted in exchange for other first-class unmounted objects in great variety.

M. A. BOOTH,  
Long Meadow, Mass.

Will exchange very thinly cut and well-stained histological and pathological slides for other histological and pathological slides. Will also exchange a limited number of histological for other slides of various kinds.

H. L. WHITNEY, M. D.,  
German Hospital, Girard ave. and 21st st.,  
Philadelphia, Pa.

Will exchange good slides of micro-fungi, various Diatoms *in situ* on algae, chemical crystals, and a fine selection of stellate hairs on leaves of plants, for other good slides.

JAS. E. WHITNEY,  
Rochester, N. Y.



# THE AMERICAN MONTHLY MICROSCOPICAL JOURNAL

VOL. V.

WASHINGTON, D. C., SEPTEMBER, 1884.

No. 9.

## American Society of Microscopists.

This Society held its annual meeting, under favorable auspices, at Rochester on the 19th, 20th, and 21st of August. For the following account of the proceedings we are indebted to the very full reports published in the Rochester *Herald*, which, although not official, bear evidence of unusually careful preparation for reports of the kind.

The address of welcome was delivered by Mr. H. F. Atwood, who was followed by the Hon. C. R. Parsons, mayor of the city, who also spoke a few words of cordial greeting.

The president of the Society, the Hon. J. D. Cox, briefly replied. Dr. Dallinger and Mr. A. W. Bennett, of England, were present.

Dr. Dallinger made a short address, in the course of which he said that it was a matter of great interest to him to be present at the meeting. As the representative of the Royal Microscopical Society he said he desired to express his appreciation of the work being done by the American organization. The speaker referred to the fact that light had been thrown on the causes of disease by the researches of microscopists. The microscopists were grappling with the source of diseases, and were endeavoring to rid society of its deadliest evils. In conclusion, the speaker said he presented the most cordial greeting to the Society.

Mr. Bennett was introduced, and referred to the vast amount of work being done by the American Society. He also emphasized the benefits to

be derived from a society devoted to practical study and use of the microscope.

Secretary D. S. Kellicott read a letter from Professor Swift, inviting the members to the Warner observatory after the evening exercises; and a letter from Messrs. Bausch & Lomb was read, inviting the members to visit their manufactory at 7.30 Wednesday evening, when all the departments would be in working order.

Dr. George E. Blackham read a paper on the 'Morphology of Rheumatic Blood,' written by Dr. Ephraim Cutter, of New York, who was unable to be present.

A. W. Bennett followed with the following paper on 'Fungi Found in Sewerage Affluents:—

'I have recently been engaged in examining the nature of the vegetable organisms found in the effluent water from works for the purification of sewage, with a view of ascertaining whether they give evidence of the purification having been inefficiently effected. Among the organisms found in these circumstances is a very remarkable one, some account of which I thought might interest the members of the American Association of Microscopists. This organism occurs abundantly in the effluent water from sewage works, and is well known to English sanitary engineers under the name of the "sewage fungus." It forms dense, flocculent, grayish-white masses attached to the bottom and sides of the channel, or to ordinary green algæ. Under the microscope it is seen to consist of an immense quantity of colorless threads, with but little or no chlorophyll, full

of granular protoplasm, and containing a number of bright, strongly refractive globular particles. It is the *Beggiatoa alba* of Voucher. The filaments are branched, either dichotomously or laterally, and the cells are frequently remarkably constricted, both above and below the septa. The globular refringent particles have been determined by German experimenters to consist of pure sulphur, and are most commonly situated immediately below each septum, but sometimes towards the centre of a cell, or more generally diffused.

The systematic position of *Beggiatoa* is somewhat obscure. Topf places it without hesitation among the lowest section of fungi, the schizomycetes, which form one division of Sachs' primary class of protophyta. It may, in fact, be regarded as the leptothrix condition of an organism of this class, having also its corresponding bacillus, coccus, and spirillum conditions. On the other hand, it appears to be closely allied to the oscillatoria through *Crenothrix*. The source of the globules of sulphur contained in this organism is a very interesting question. The *Beggiatoa* is not necessarily indicative of partially decomposed sewage; it occurs also in the effluent water from manufactories, especially sugar factories and tanneries, etc., thermal sulphur springs, as well as in drains. It appears, therefore, to have the power of extracting sulphur, not only from decomposing organic matter, but also from the mineral sulphates dissolved in spring water. Sulphur may be set free in this way by the mutual decomposition of soluble sulphides and sulphites. Independently of the source of sulphur is the organic matter present in the sewage itself. There is an abundant supply of this element in the substances used for purifying or precipitating the sewage, which are usually sulphate of alumina, lime, and protosulphate of iron. The growth of the so-called sewage fungus must undoubtedly,

therefore, be regarded as evidence of the presence in the water of an abnormal amount of sulphates, derived either directly from sewage or the substances used in precipitating it, or in other ways in manufactories. But there seems no reason to believe that it will itself have any injurious effects on the water. It is difficult to see how the sulphur, once set free, can again combine with hydrogen to form sulphuretted hydrogen gas, as long as the organism is growing in the water. Indeed, if allowed to accumulate and periodically removed, it may tend to purify the water by abstracting from it some of the undue proportion of sulphur.

Dr. Dallinger and Professor Lattimore briefly discussed the paper, emphasizing the necessity of making such researches as that described in Mr. Bennett's paper.

William J. Lewis, of Hartford, read the following paper on 'Hair, Microscopically Examined and Medico-legally Considered':—

'In the field of forensic medicine, however, we necessarily must regard the microscope as being in the infancy of its service. I need only remind you that in this branch of our work no one subject, probably, has received such careful and thorough study as that of blood-stains; and yet, after years of pains-taking research and experiment—years of attentive labor by many of the brightest lights whose names and whose works have illumined the annals of science—let me ask who, at the present day, aided by the most accurate instruments at our command, is able and willing to enter the witness box and swear, without reserve, that a certain stain which has been submitted to him for an examination was made by human blood? If, then, in stains existing under many varying conditions and circumstances, but which are readily demonstrated to be blood, we are yet unable to distinguish human from animal blood with absolute certainty, we see how important it becomes to



utilize all corroborative proof within our reach which may assist in determining the kind of blood under inspection. And where may we look for this additional information? Evidently in the clot or stain itself. It probably seldom occurs in a murderous assault that blood stains, found on the weapons used, are formed without entangling in their substance more or less extraneous matter, and this material is not unfrequently hair or textile fibres of one sort or another which, when examined by the microscopist, will disclose presumptive proof. Such evidence may assist in delivering into the hands of justice the perpetrator of a crime who might otherwise successfully elude detection, or it may with equal force establish the innocence of a suspected person. What the microscopist may do to assist in determining questions of this nature, it is the purpose of this paper to briefly touch upon, and more especially to consider that feature to which we have alluded in speaking of hair and filamentous substances generally in their relation to legal medicine.

If the object under observation is that of hair, it becomes at once necessary to determine, if possible, whether it is human or animal; and, if found to be of the latter kind, whether it is of its original, natural color, or has been stained by the dyer. To become practically familiar with the many varieties of fur, such as are in common use as articles of wearing apparel, and to recognize the changes in hue wrought in hair by dyes to which it has been subjected, opens up an important and extensive field to the forensic microscopist, and one which as yet has received but comparatively little attention. The importance of closely inspecting weapons, and of carefully examining hair found upon them, may best be shown by a few illustrative cases. In a case quoted by Dr. Taylor, a hatchet, having clotted blood and hair adherent to it, was produced as evidence against an

accused person, under whose bed the weapon had been found. This, with other circumstantial evidence, had turned public opinion strongly against the prisoner; but when the hair was examined it was found not to be human, but to have been taken from the body of some animal. This circumstance led to a more complete sifting of the evidence, and the prisoner was acquitted. It turned out that the prisoner had killed an animal with the hatchet, and had carelessly thrown the weapon under his bed. Some years since a little girl was murdered in one of our large cities, and the appearance of wounds which had been inflicted upon her head indicated that the weapon used was some blunt instrument. A club stained with blood was found near by. The counsel for the accused person endeavored to show that the club had been used by the prisoner for the purpose of killing pigeons. The club was submitted to examination, and there were found in the clots thereon and in the splintered portions of the weapon certain hairs which were identified by others and myself as fine hairs from a human head. By comparison, they were in every respect precisely like hair taken from the head of deceased.

In the case of an alleged murder in Connecticut, where the charred bodies of two women had been found in the debris of their dwelling, which had burned to the ground, I was employed by the State to make an examination of certain pieces of half-burned cloth, some partly-singed hair, and numerous other fragmentary substances. I found considerable blood in unburned portions of the cloth, but, owing to the high temperature to which it had been exposed, the corpuscles could not be sufficiently restored to determine, even approximately by the aid of micrometry, whether they were of human or animal origin, and it was not known whether there was an animal in the house at the time of the fire, or not. I found, however, some hair which

had been matted together by blood previous to its being heated, and was able in that case to show that the hair was from the head of an adult dark-complexioned person. One of the most important features developed during this trial was the ability to show that the blood in the meshes of the hair was ante-mortem.

‘In cases of forensic microscopy the importance of a careful examination of all minute fibres found upon weapons cannot be too strongly insisted upon. A case is related where a razor was found which belonged to a prisoner, on which were some small fibres imbedded in blood, which, examined under a high magnifying power, proved to be cotton. In cutting the throat of his victim, the murderer has also cut through the cotton strings of her night-cap. The similarity of the cotton fibres on the razor belonging to the prisoner and those of the strings on the deceased woman’s night-cap was fully established. In another case, a knife which had been used to inflict a fatal wound, and which had been wiped afterward, contained in its depressions and irregularities, as well as between the layers of the handles, coagula of recent blood mixed with rust. One remarkable circumstance brought out by the microscope appeared to connect the weapon with the prisoner. In a small coagulum found on the knife, dried and fixed to the blade, were some woollen fibres of a peculiar purple brown dye. These corresponded exactly to the fibres of the woollen jacket which the prisoner wore. In examining hair for the sole purpose of determining whether it came from man or animal we will find sufficiently characteristic differences in that portion known as the shaft, and we will, therefore, limit our remarks to that part only, which, in fact, is often the only portion of the hair we are able to obtain in medico-legal practice. The appearance of the hair shaft varies considerably in different persons, as it does

also in the same person upon different parts of the body; but there is, nevertheless, the same general structure which enables us to identify it with little difficulty when under the microscope. Before entering upon the distinguishing features of human from animal hair, it will save repetition if we first briefly refer to the general structure of the hair shaft.

‘When we examine a hair, properly mounted under a low or medium power, we can usually discern at once its two principal anatomical parts, the cortex and medulla. The medulla, forming as it does a dark central axis in the hair, gives it the appearance of a tube—an illusion which led some of the earlier observers into error. A thin transverse section of the shaft at once corrects this impression and shows the medulla to be composed of cells of variable size and shape. These cells usually contain dark, coarse spots which were at one time supposed to be deposits of pigment, but have since been shown to consist of air. This can be easily demonstrated by allowing a longitudinal section of hair to soak in some volatile oil, when the air will be displaced by the oil, and the spots disappear and again reappear upon evaporation of the oil. The size and shape of these medullary air cells, as we shall see later on, form one of the most noticeable distinctions between animal and human hair. The linear portions or cortex, which surrounds the medulla, is made up of flat and generally nucleated cells, the borders somewhat overlapping each other. The minute anatomy of the cortex cannot be made out without first subjecting the hair to special preparation. By treating a human hair, preferably a white one, with caustic soda or potash, the cell walls become plainly visible; and, by desiccation in warm nitric or sulphuric acid, the individual cells may be obtained, showing oftentimes with beautiful distinctness their elongated nuclei, and frequently in dark hair,



pigment markings. The cortex of a human hair, especially, is hard, tough, and yet elastic. This permits of brushing, combing, and of even much rougher treatment without injury to its normally smooth contour. We would remark, in passing, that this is a point of some value in forensic microscopy, as we frequently find dents, of more or less depth, in hair taken from weapons which have been used in assaults. Such dents or other injuries to the cortex, when observed in hair remaining on the victim's head, may lead to a presumption as to the kind of weapon used.

‘With these remarks we may now inquire into the characteristic distinctions which exist between human hair and animal hair. For the purpose of convenience they may be considered under the following heads, viz : First, The relative proportions of the cortical and medullary structures. Second, The size, shape, and arrangement of the medullary cells. Third, The size, shape, and arrangement of the superficial cortical cells. Fourth, The size and shape of the hair shaft.

‘First, the relative proportion of the cortical and medullary structures. In animals, the medulla almost always forms a much larger proportion of the hair shaft than in man, though there are a number of exceptions to this general rule. In hair from certain quadrumana, the monkey for example, the relative proportion of medulla is about the same as in the hair from man, though its appearance is different. The stronger and denser the hair, the greater is the thickness of the cortical structure, while, conversely, the lighter, more pliable, and spongy the hair the greater is the proportion of the medulla. This rule is well illustrated in such typical examples as the pig's bristle, intended more for protection than warmth, with its hard, horny cortex and proportionally small medulla, and on the other hand the soft, pliable, though coarse hair of the deer, with its thin delicate cortex and

full spongy medulla, evidently constructed as much for warmth as protection from violence. So universal is this rule that, with a full knowledge of the life history of a given animal, we can form an opinion as to the relative proportion of cortical and medullary structures with considerable accuracy, even before we have made a microscopic observation.

‘Second, size, shape, and arrangement of medullary cells. In human hair we find the medullary cells of variable size, irregularly round, that is, in such diverse shapes as globular cells assume when in close and crowded aggregations. They differ in general appearance from the corresponding cells in most hairs of animal origin. They are smaller, more crowded, and unless specially prepared, less distinct than the medullary cells in animal hairs of the same diameter. In hair from most of our domestic animals we find the size, shape, and arrangement of these cells to be so totally unlike those in human hair as to be contradistinguished at a glance when properly mounted and viewed under a good glass by transmitted light. In the rodentia, for example, these cells are mostly arranged in pretty regularly longitudinal lines, the medulla in the finest hairs being composed of but a single row of more or less distinctly separated cells.

‘Third, the size, shape, and arrangement of the superficial cortical cells. In human hair these are thin, flat, and usually fusiform, superimposed flatly one on another, and overlapping so as to give the appearance of very fine irregular transverse striæ on the surface of the hair, and a delicate serrated edge on the outer borders. The projection of these superficial cortical cells is only equal to the thickness of a single cell. On the other hand, in animal hair, where the cortex at all resembles that of human, the striæ are coarser, more distinct, the lines more widely separated and the edges generally more deeply serrated. In many

hairs the projection of the superficial cortical cells is so great that instead of the striated appearance, we have a rough surface thickly studded with obliquely projecting points or spurs; or we may find the scales arranged in handsome whorls at regular intervals as in the hairs of some bats.

‘Fourth, the size and shape of the hair shaft. Hairs from different parts of the same person or animal vary in size. So also do hairs from the same animal, when collected at different seasons of the year, vary considerably both in length and thickness. As a means of identity the diameter of the human hair is important when considered in connection with a considerable number of measurements made from hairs from a known source. Measurements taken of the diameter of a hair for the purpose of ascertaining whether it is of human or animal origin are of little or no use, but measurements made of the thickness of the cortex and diameter of the medulla, whereby the relative proportion of each may be obtained, are of considerable value.

‘The shape of hair varies in persons and in animals. Hair from the human scalp is cylindrical and with smooth contour, while animal hairs are of various shapes—some oval, others branched, and many are constricted in diameter at regular intervals along the shaft. Of the latter kind we may mention that of the mouse, where we find the hair is round and contains a number of rows of medulla cells which gradually diminish at the constricted part, and increase in numbers as we examine the larger part, and so on through the entire length of the shaft, producing several symmetrical contractions and expansions in the hair.’

In discussing the paper Dr. Stowell said he had been given a rib of some animal, covered with hair. He had at first thought this covering was a parasitic growth, but an examination showed that the hair, if such it was, grew from the centre of the

bone. Dr. Dallinger said it was a fact worthy of notice that the hair of different races was dissimilar in some particulars. J. D. Hyatt, of Morrisania, said the fact that hair remained unchanged for years was proved by an experiment he had made. He had examined the hair of a Peruvian mummy at least 300 years old, and found that it did not differ from a young person's hair with which he compared it.

In the evening, ex-Governor Cox, president of the Society, delivered his annual address in the city hall. The speaker was introduced by Professor S. A. Lattimore, of the University of Rochester. The address was in one sense a memorial of one of the most distinguished members of the Society, Robert B. Tolles, one of the pioneers in the introduction of modern wide-angled lenses, and in whose death, which occurred within the last year, the scientific world sustained a great, almost an irreparable loss. The speaker gave a historical sketch of the great debate over the practicability of enlarging the aperture of microscope objectives beyond the maximum angle in air in which Tolles' part was by common consent the leading one practically. President Cox endeavored to show by a careful review of the discussion that Tolles deserved to rank high in it for clear and accurate scientific comprehension of the principles to be applied, and that he had passed beyond the field of the skilful artisan into that of a systematic and able investigator who worked toward valuable results by the proper application of well-understood laws.

The address occupied an hour and a half in its delivery.

After the address in city hall about fifty members of the Society visited the Warner observatory in response to the invitation of Professor Swift.

The second day's session was opened by a paper by Prof. D. S. Kellicott, treating of new species of infusoria discovered by him during



the year. Dr. George E. Blackham read a memoir of Robert B. Tolles. It is too long to publish in full, but we give the principal part of it as follows:—

‘I am indebted, for most of the facts now presented, to the kindness of Mr. and Mrs. A. M. Lewis, of Chicago, Ill., the sister and brother-in-law of the subject of this paper. The story is a simple and touching narrative of the struggle of genius with poverty and ill-health, of steady persistence in the face of apparently insurmountable obstacles, and of final and triumphant success, when he finally yielded to the fatal malady which had so long tortured him, and died in the hospital, leaving scarce enough of this world’s goods to defray his funeral expenses, but universally acknowledged as among the first, if not, as many of us believe, the very first optician of his time. The story of his life is as follows:—

‘Robert B. Tolles was born in Winchester, Litchfield county, Conn. He was the son of Elisha and Harriet Tolles, and the second of five children, two sons and three daughters, of whom the daughters only are now living. They are Mrs. Helen M. Clarke, with whom he made his home for the last few years of his life, and Mrs. Mary A. Grant, both in Boston, Mass., and Mrs. Harriet S. Lewis, in Chicago, Ill. His early life was spent at home on his grandfather’s farm near by, where he worked to aid in supporting the family, who were very poor. His educational advantages were very limited, being only those offered by the common district school. He was, even then, an eager seeker after knowledge, and earnestly desired a collegiate education, but poverty and ill-health combined to prevent him from attaining this object of his ambition. At the age of eighteen he suffered from a very severe attack of pleurisy, from the effects of which he never wholly recovered, and which probably laid the foundation for his

life-long sufferings. His father, from whom he doubtless inherited much of his genius and skill, was an inventor, and several of his inventions were patented, but he seems to have realized very little pecuniary advantages from them—partly, no doubt, because his poverty prevented him from developing them. He died of cholera, in Cincinnati, Ohio, in 1848.

‘After the death of his mother, in 1843, Robert, just then of age, went to visit an uncle residing near this city—Rochester, N. Y.—performing much of the journey on foot, as he was too poor to afford the luxury of traveling by public conveyance. When his visit was finished he started for New-York city, stopping on the way at Canastota, N. Y., when a happy chance led him to the little workshop where Charles A. Spencer was turning out the wonderful optical work which was at once the admiration and the despair of the old-world opticians. The young Yankee boy looked about him, and in that moment saw his life-work before him. “Here,” said he, “is the place and the work for me.” Soon after he entered the service of Mr. Spencer as an apprentice, and as apprentice and journeyman he remained with him till 1858, when he started in business on his own account in a little loft in Canastota.

‘In 1867 he received, through Mr. Charles Stodder, a proposition from several Boston gentlemen to remove his business to that city and organize it under the name of the Boston Optical Works, with himself as superintendent. The offer was accepted and the business carried on in this way for four years, when it was deemed best to place the business entirely in his hands, and from that time until his death, on the 17th of November, 1883, R. B. Tolles and the Boston Optical Works were one and the same. In 1853 he married Miss Frelove S. Dickey, but after less than a year of matrimonial happiness was left a widower, as she died in

March, 1854. Mr. Tolles combined many qualities essential to the great work of his life, the improvement of the microscope. To great theoretical and practical knowledge of the science of optics he united mechanical and inventive genius and marvellous skill of eye and hand. While still in the service of Mr. Spencer he devised the form of cover-correction for objectives in which back and middle combinations have a rectilinear motion only, and the front remains entirely stationary. In 1853 he invented and patented his solid eye-piece. In 1858 he made his first immersion objectives, though, of course, this plan was not original with him. In 1858 he constructed objectives with two fronts, one to be as an immersion and the other dry. In August, 1873, he made the great step forward which placed him at the head of his profession, the Columbus of a new era of microscopy. He made an immersion one-tenth with an aperture greater than that corresponding to infinitely near 180 degrees in air. It was a three-system lens, and had an aperture of more than 110 degrees in balsam, or 1.27 N. A. The same month he made his first lens of the duplex front formula a one-fifth, glycerin immersion of 110 degrees balsam angle. Both passed into the possession of the Army Medical Museum at Washington, and both were practically homogeneous immersion lenses, as they gave the very best results when immersed in soft balsam, which had been brought as nearly as possible to the same index of refraction as the crown-glass of which their front lenses were made, viz., 1.525. The importance of this bold step and its influence upon the progress of microscopy can scarcely be estimated at this time, but it is certain that it was the cause of a revolution of opinion and practice among users and makers of microscopes all over the world.

‘Mr. Tolles was the inventor of many other devices and appliances for the microscope. In 1866 he in-

vented and patented his stereoscopic binocular eye-piece; in 1878 he received two patents for improvements in the microscope stand. For years his stands were models of elegance, convenience, and stability, and his mechanical stages are, I believe, unequalled to-day for delicacy of construction and perfection of working.

‘During his last illness, when he could no longer go to his shop, he had his microscope brought to the hospital, and there on his death-bed examined and tested his lenses till the physician took it from him and forbade his using it longer. The amount of suffering he endured can hardly be estimated, but the fact is that many a night during the last two years of his life he could only get a broken sleep while sitting up in his chair, the condition of his lungs making it impossible for him to lie down.’

Professor Kellicott read an abstract of a paper entitled ‘Observation on Infusoria, with Descriptions of New Species.’ Dr. Frank L. James read a paper on the ‘Deposition of Silver on Glass.’

A committee consisting of Professor Rogers, Dr. Blackham, and Dr. Detmers was appointed to report a plan for securing funds with which to erect suitable monuments to the memory of Robert Tolles and Charles A. Spencer.

At the afternoon session Ernst Gundlach read the following paper on ‘Improvement in Objectives:’—

‘Eight years ago I presented to the American Association for the Advancement of Science a description of a new quadruple objective for astronomical telescopes. The general acknowledgment with which the paper was received, and the high estimation of the theoretical principles of the invention, by scientific authorities of this country as well as Europe, encourage me to present to this Association a description of another improvement in objectives, which I expect will be of equal value to both the telescope and the microscope.



Although I have unfortunately not had sufficient opportunity for properly executing an objective of the first mentioned description, and thus practically demonstrating the advantages of the same, I must confess that during the time I have become conscious of a practical defect of the same, which is the increased number of lenses. I am now of the opinion that any improvement of objectives which requires additional lenses will always be objectionable, however valuable the improvement may otherwise be. The objective which I now wish to describe is free from this defect. It consists of two lenses only: one of crown and one of flint glass, like the ordinary objective. But the formula for the same is based upon a new principle.

My object in this paper is to show that for the best possible construction of an achromatic objective the proper figure or proportion of curvatures of the crown-glass lens is an important factor, submitted to a positive theoretical law, and that, as a consequence of the neglect of this law, the present objective is far from having the best possible form. The angular aperture, or in other words, the proportion of aperture to focal distance of an objective, is limited by the spherical aberration of the crown-glass lens, because the latter greatly increases with the increase of the angular aperture, and consequently the aberrations of the higher order are increased. But this limit can be extended, if the spherical aberration of the crown-glass lens can be, without change of focal length and diameter, reduced by a mere change of curvature, because this reduction involves a corresponding reduction of the aberrations of the higher order. According to this, we can imagine two achromatic objectives which are equal in focal distance and aperture; but, although the flint glass lenses of both have the best possible form for correction of the aberrations of their respective crown-glass lenses, one of the lenses is superior to

the other in correction of the aberrations of higher order, because the spherical aberration of the crown-glass lens is less than that of the other. We now arrive at the question whether the spherical aberration of the crown-glass lens of the present achromatic objective can be reduced by a mere change of proportion of curvature, and, if so, what is the theoretical law after which this proportion has been found? This law, which I have found by careful study, may be expressed as follows: The spherical aberration of a lens for rays of given direction will be a minimum if the proportion of the curvatures of the refracting surfaces is such by which the angle of refraction of the medium ray at the entering surface is equal to that at the emerging; or, in other words, by which the angle of the perpendicular inclination of the medium ray at the entering surface is equal to that of the emerging surface. If the rays entering a lens are parallel or nearly so, as is the case with the telescope, then they will, after having passed through the lens, be changed by refraction to a converging direction toward the focal point of the lens, and to be equal in perpendicular inclination upon their respective surfaces. The entering or first surface will certainly have to be of correspondingly shorter curvature than the emerging or second surface. For a lens of a relative focus and diameter, as the crown-glass lens of the present telescope, the radius of the curvature of the inner surface will have to be about twice as long as that of the outer surface to fulfil the condition of minimum spherical aberration. But we are familiar enough with the construction of our present objective to admit that just the contrary is the case; that is, the curvature of the outer surface of the crown-glass lens is by far the longest. If the crown-glass lens is reversed, so that the inner or shorter curved surface is brought outside, toward the parallel rays of the object, then the

form of the lens would much nearer fulfil the conditions of minimum spherical aberration. But then, of course, the flint-glass lens will no longer have the proper form as a correcting lens; it would now over correct the aberrations of the crown-glass lens, and therefore a more flat, long-curved form of the same would be required. If the exact form or curvature of minimum aberration of the crown-glass lens, as well as that of the correcting flint-glass lens, as found by calculation, is compared with the present objective, it will be found that the aberrations of higher order in the new objective are reduced to about one-third of the old one, and a corresponding gain in the definition and reduction of color, or otherwise an extension of the limit of aperture must be the result.

'In my foregoing description I have, for the purpose of avoiding complications and giving a clearer understanding, referred to the telescope only; but as the construction of this instrument is submitted to the same theoretical laws as that of the microscope, little remains to be said about the application of the described new principle to the microscope.'

Mr. H. F. Atwood followed with a paper on 'New Apparatus for Photo-micrography.' The paper was as follows:—

'At our meeting last year at Chicago Mr. Walmsley, of Philadelphia, read a valuable paper on photo-micrography. No doubt many others have, like myself, become enthusiastic on the subject, and have done much work in that direction. Benefiting from the hints derived from Mr. Walmsley's paper, I some months ago attached my Griffith Club microscope to a camera, and with it did some very creditable work. It was not, however, satisfactory to me wholly, and the thought occurred to me that if a combination of camera and microscope could be produced at a reasonable cost it would, like a country newspaper, fill a long-felt

want. I finally submitted to Edward Bausch a drawing that, besides conveying an idea of what I wanted, represented the consumption of an unknown quantity of brain tissue. He went to work on it, corrected my errors, added new ideas, and as a result I have the pleasure of presenting and describing to you to-day an apparatus capable of doing any work in photo-micrography perfectly, and that can be put in the hands of the microscopist at an expense less than that of ordinary camera attachment for his microscope. As the apparatus is before you there is hardly a necessity for me to describe it in detail.'

Mr. Atwood explained the apparatus in detail, and showed specimens of photo-micrography. A discussion followed as to whether it was advisable to work with or without eye-pieces. Mr. Atwood said he obtained a denser and clearer plate without an eye-piece. President Cox said he had obtained the best results with an eye-piece. Dr. Blackham took the same ground. He thought the microscope had been manufactured with the intention that the eye-piece should be used in photo-micrographic work. He thought the prejudice against eye-pieces unreasonable. After an image had been focussed the instrument was thrown out of adjustment if the eye-piece was removed. Prof. Burrell said he had started out with a prejudice against eye-pieces, but, notwithstanding, he had found that better photo-micrographic work could be executed by their use.

President Cox announced that he had communicated to Dr. Dallinger that the latter had been elected a permanent honorary member of the organization. Dr. Dallinger said: 'Not only on my own account, but on behalf of the society I represent, I accept the honor with the greatest pleasure. While I have been among you I have felt that my interest in microscopy has widened. I feel that there is more earnest work being



done here than I have hitherto realized. Anything I can do to further your interest I shall do with the greatest pleasure.'

Professor William A. Rogers read a paper on a 'New Form of Section Cutter.' The two features of a section cutter in which the speaker thought improvement could be made were: First. A method of moving the plate to which the section to be cut was attached over a definite and a known distance. Second. A method of firmly holding the plate in position during the operation of cutting the section. The speaker said it was proposed to move the plate between two vertical walls as guides over the distance required as indicated by a graduated scale attached to the plate and in the focal plane of an objective attached to the frame upon which it moved. The movement of the plate might be made either by a screw or by tapping with a small hammer. In order to hold the plate firmly in position after the movement had been made under the microscope the plate rested upon the poles of four magnets, which projected through the frame from beneath. When the circuit was completed the plate suffered no disturbance, since it rested directly upon the cores of the magnets. Disturbance was only produced when there was motion. Here no motion could take place. Moreover, the observer, by an examination of the graduated scale while the circuit was being completed, could be sure that the operation of clamping had produced no disturbance in position. Professor Rogers illustrated his plan by diagrams on the black-board.

Mr. H. F. Atwood announced that tickets for the soiree at the arsenal this evening could be procured of Secretary Kellicott. He said that already 2,000 tickets had been issued. There were to be 125 microscopes in the exhibition.

Mr. E. H. Griffith described a working cabinet which he had de-

signed. He exhibited the cabinet, which contained places for all the apparatus connected with the microscope. He also exhibited and described improved turn-tables and nose-pieces which he had invented.

Dr. Blackham, of the memorial committee, read the following report:

'Your committee would respectfully report that in their opinion this Society should express its willingness to receive and care for any moneys which may from time to time be voluntarily contributed for the purpose of perpetuating by suitable memorials the memory of the late distinguished opticians, our late honorary members, Charles A. Spencer and Robert B. Tolles, and we therefore offer the following resolution:—

'*Resolved*, That the treasurer be directed to open two accounts with the Charles A. Spencer memorial fund and the Robert B. Tolles memorial fund, and credit to each all moneys contributed for that purpose, and invest them securely till such time as an amount may be accumulated which this Society shall deem sufficient to pay for suitable memorials, and shall report at each annual meeting of this Society the state of each of said funds.'

The resolution was adopted, after which the Society adjourned.

In the evening the members of the Society, accompanied by many of their friends, visited the manufactory of Bausch & Lomb. The grounds were brilliantly illuminated. All the departments of the manufactory were in operation, and the visitors made a thorough inspection under the guidance of several employés, who explained all the processes. Later the visitors assembled in a large tent on the grounds, where an elaborate supper was provided.

The proceedings of the third day were opened by a long paper by Dr. Geo. E. Fell on some 'expert testimony in a forgery case,' mainly devoted to the detection of different inks in a document by their color.

Ernst Gundlach at this point read a short note explaining a former paper on the question of making homogeneous immersion objectives with adjustable mounts. Edward Bausch read a paper on the universal or society screw for the microscope. On motion of Professor Burrill, Mr. Bausch and Professor W. A. Rogers were appointed a committee to confer with the Royal Microscopical Society to secure, if possible, some understanding in the matter of the society screw. The next paper read was by Professor Henry Mills, of Buffalo, entitled 'Thoughts on the Spongidae.' Dr. George E. Blackham read a paper written by W. H. Bulloch on the 'Magnifying Power of Microscope Objectives.'

Dr. R. H. Ward, of Auburn, read by abstract his paper on 'A New Lens Holder and Iris Illuminator.'

President Cox called for the report of the nominating committee. Professor Henry Mills, of Buffalo, chairman, read the report as follows:—

President—Professor W. A. Rogers, Cambridge, Mass.

Vice-Presidents—H. F. Atwood, Rochester; Professor Chas. H. Stowell, Ann Arbor, Mich.

Secretary—Professor D. S. Kellicott, Buffalo.

Treasurer—Dr. George E. Fell, Buffalo.

Executive Committee—Charles E. Shepard, M. D., Grand Rapids, Mich.; A. B. Harvey, D. D., Taunton, Mass.; L. M. Eastman, M. D., Baltimore, Md.

The report was adopted.

The report of the committee on eye-pieces was called for and read by Dr. R. H. Ward. The report recommended that standard sizes of eye-pieces be adopted, and suggested a method of establishing a uniform system of nomenclature.

Professor Rogers gave a description of his method of making fine rulings on glass. An interesting discussion followed. The treasurer's report for the past year showed a bal-

ance on hand of \$380.53, which will be augmented by \$440 when the unpaid dues are settled.

At the afternoon session J. F. Brownell read a paper on 'An Original Method of Staining and Mounting Pollen.' Dr. Blackham read a paper written by Dr. A. C. Mercer on 'An Improved Form of Watch Glass.' A specimen was exhibited. President Cox said he had used ordinary salt-cellars for the same purpose. 'A New Mounting Medium' was the subject of Professor H. L. Smith. The medium was a composition of arsenic and antimony. Professor Smith explained the mode of preparation and referred to its peculiar advantages.

The subject of Mr. F. M. Hamlin was 'An Ideal Slide.' He made a diagram of a slide in which the cell was sunk below the surface. The cover was attached at points where the cement could not affect the mounting medium. He said such a slide would cost more than those in common use, still its advantages would make it desirable even at an increased cost. Professor Smith exhibited a grooved slide which he had found useful. President Cox said the sand blast might be utilized in the manufacture of such slides as Mr. Hamlin described. The paper on a 'Cover-glass Cleaner' was read by Secretary Kellicott, in the absence of the author, F. L. James. Secretary Kellicott read the following letter from the newly-elected President, W. A. Rogers: 'I have been deeply moved by the expression of confidence shown in my election as president of the Society for the ensuing year, but I am certain the best interests of the Society would not be served by my acceptance. It is my present purpose to be absent from the country during the summer and fall of 1885. Will you, therefore, communicate to the Society my declination of the great honor conferred. I need not say that it will always be both a duty and a pleasure for me to do anything in my power to



promote the interests of the Society and to justify the confidence in me shown by the election, but under the circumstances I cannot but think it wise to make another selection.'

Prof. H. L. Smith was finally chosen in place of Prof. Rogers.

President Cox followed with a description of the diatom shell. Stereopticon views were exhibited illustrating the different forms of shells. The speaker showed that the dotted markings in the diatoms were alveolæ, and not solid spherules.

It was voted to refer to the executive committee the question of deciding upon the time and place for the next annual meeting.

The soiree is said to have been 'the most brilliant event in the history of the organization.' There were 125 tables and 252 exhibits, and 'at least 2,000 persons' to examine them.

The afternoon was devoted to a practical illustration by experts of methods of executing the many delicate and different operations connected with microscopic work. The experts occupied twenty-eight tables, and explained in detail all the work which was executed. This plan of illustrating practical methods was inaugurated a year ago, and is destined to become one of the most important features of the annual gatherings.

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## EDITORIAL.

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**Publisher's Notices.**—All communications, remittances, exchanges, etc., should be addressed to the Editor, P. O. Box 630, Washington, D. C.

Remittances should be made by postal notes, money orders, or by money sent in registered letters. Drafts should be made payable in Washington, New York, Boston, or Philadelphia.

Subscription-price before April 1st, \$1 per year, in advance. All subscriptions after this month begin with the January number. After April 1st the subscription-price will be \$1.50.

The regular receipt of the JOURNAL will be an acknowledgment of payment.

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—The JOURNAL is late this month, owing to the absence of the editor, who was in attendance at the meeting of the A. A. A. S., and was unexpectedly detained at Philadelphia

and unable to get the proofs, which had been sent on to New York. Correspondents who have not received prompt replies to their letters will thus understand the cause of delay. The Editor will be absent during the remainder of the present month, but letters addressed to Washington will hereafter be forwarded to him.

—O—

MR. L. R. SEXTON.—Information has rather tardily reached us, owing to absence from home, of the death of Mr. L. R. Sexton, of Rochester, who has been well known to all of our readers as a dealer in microscopical apparatus. Owing to the late date of receiving this information a suitable notice of his life and connection with the microscope trade must be deferred until next month.

—O—

DR. JOSEPH JANVIER WOODWARD.—Another prominent microscopist and physician has passed away. Probably no man in his profession has been so widely known as Col. Woodward, during the active part of his life as a medical officer and experimenter.

It is seldom, indeed, that a man passes away in these days leaving a place that cannot be filled by another equally qualified to continue his work. He had undertaken too much, and despite unfailling energy and a strong physical constitution, the strain was too great, and his active mind gave way. Probably there is not a man so well fitted by experience and special study to complete the great work upon which he was engaged, the first volumes of which will be an enduring monument to his knowledge and industry.

The following notice of his death appeared in the *New York Herald* of August 19th:—

'The War Department has been informed of the death, yesterday morning, near Philadelphia, of Colonel J. J. Woodward, surgeon, United States Army. Surgeon Woodward was one of the physicians in attend-

ance on the late President Garfield, and had been in bad health for a long time. He was born in Philadelphia in 1833. He was educated at the Philadelphia Central High School, from which he received the degree of A. B. in 1850, and that of A. M. in 1855. He studied medicine in the medical department of the University of Pennsylvania, and, after graduating, practised medicine in Philadelphia. He was a good surgeon, and, in addition to his practice, gave lessons in microscopical and pathological anatomy.

Entering the army in June, 1861, he saw much active service, and rose rapidly. He was present at the siege of Yorktown, and the battle of Williamsburg, Va. He was breveted captain, major, and lieutenant-colonel in the United States army for faithful and meritorious services, and was assigned to the Surgeon-General's Bureau, at Washington. He was appointed chief-assistant soon after. He was the medical editor of the "Medical and Surgical History of the Rebellion." His professional labors were of distinguished character, none more so than his comprehensive series of experiments in microscopic photography, by which the profession has been placed in possession of records of the highest value and usefulness. Among his published papers are "Address on the Medical Staff of the United States Army," "Remarks on Croup and Diphtheria," "Typho-Malarial Fever—Is it a Special Type of Fever?" *Transactions* of the International Medical Congress of 1876, "Remarks on Photographic Micrometry," *Transactions* of the American Medical Association of 1876, "Application of the Photograph to Micrometry," with special reference to the micrometry of blood in criminal cases, *ibid.*; report on "Medical Literature," *ibid.*, 1870; report on "Causes and Pathology of Pyæmia," (Septæmia,) *ibid.*, 1866. He was a member, during his residence in

Philadelphia, of the Philadelphia County Medical Society; was a member of the American Medical Association, and was second vice-president in 1875; was a delegate to the International Medical Congress at Philadelphia in 1876, and of the Medical Association of the District of Columbia. He was married; and at the meeting of the American Medical Association, at Richmond, in May, 1881, was elected its president.

Microscopists will recall many other contributions to his favorite study, in foreign journals, and more recently to this journal, and its predecessor, the *Quarterly*. Of late years, however, he has done but little work, and his last contribution to microscopy, which we can now recall, was published in the second volume of this journal, page 29, entitled 'Supplementary Note to the Notice of Riddell's Binocular Microscopes.'

He was personally known to many who read these lines, and to all who have known him well his loss will be deeply felt.

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AMERICAN SOCIETY OF MICROSCOPISTS.—The officers of the American Society of Microscopists have reason to congratulate themselves upon the large attendance of members at the meeting last month. The local committee deserves to be congratulated upon the success of their efforts for the entertainment of the members. As a social gathering the meeting was, as all accounts indicate, a perfect success. The reader may judge of the scientific value of the proceedings from the rather full account published in these columns. We have given place to a longer report than usual because the daily press reports are unusually good, and it has seemed a subject of sufficient general interest to be brought forward promptly, to the exclusion of other matter. The papers read were certainly of some interest, but they were



not, as a whole, characterized by very profound treatment of the subjects, and it is to be hoped that the next annual volume of *Proceedings* will not be regarded as representing the results of American microscopical investigation and discovery during the past year. The society undoubtedly has a place to fill, and as an association of amateurs, which it essentially is, it may exert an influence that will lead to truly scientific research with the microscope in the many paths open to the observer.

The society has our best wishes, and will have in future, as in the past, such assistance and encouragement as it may be within our power to give. The mere fact that its meetings and its publications tend to spread abroad among people of all classes a knowledge of the microscope and its revelations, thereby contributing more or less to the dissemination of knowledge, ensures our earnest support.

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THE AMERICAN ASSOCIATION.—The meeting of this Association was held in Philadelphia from the 4th to the 11th of September, with an attendance of 1,250 registered members, including a large number of members of foreign scientific societies, some of whom were present as delegates. Among the latter were the Rev. Mr. Dallinger and the venerable James Glaisher, from the Royal Microscopical Society, London, and Mr. J. C. Thompson, of Liverpool, who attended some of the meetings of Section G.

The American Association includes in its membership many of the leading thinkers and investigators of the country. It has a large membership of persons who make not the slightest pretensions of scientific knowledge, but among its Fellows, and especially among those who have held official positions at its various meetings, will be found some of the leading scientists of the country.

The meeting which adjourned but

a few days ago in Philadelphia was characterized, as usual, by an abundance of social recreation, but the scientific papers received due attention. Section G, the section of histology and microscopy, held very interesting meetings, which will be fully reported in this JOURNAL next month. So much space has already been taken up with the report of the Rochester meeting that it has seemed best to defer more than this brief notice of the meeting of the Association until the next issue of the JOURNAL. It may be said, however, that the papers presented before the Microscopical Section, although few, were carefully prepared and some of them of unusual interest and value. They will be published in this JOURNAL.

It is well known to those who have taken an active interest in the Association that the advisability of establishing a microscopical section was questioned from the time the proposition was first made. Experience seems to have shown very clearly that by far the greater number of papers brought before the section of Histology and Microscopy are of a nature to interest the biologists, and while a comparatively small number seem properly to belong strictly to a microscopical section, it appears that even these would find appropriate places in other sections. In view of these facts the question of changing the section, and making it subordinate to one of the other sections, was brought forward at one of the meetings of the section and freely discussed. While a few members strongly favored the present arrangement, which, indeed, possesses certain features to commend it, a larger number were of the opinion that in an association representing all branches of scientific study the microscope finds so many applications that it is not desirable to maintain a special section for purely microscopical papers.

It is probable, therefore, that after next year the present microscopical section will either be made a sub-

section, perhaps attached to the section of biology, or possibly it will be abolished entirely, which will permit of the distribution of microscopical papers among the sections in strict accordance with the subjects upon which they treat.

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THE BACILLUS OF CHOLERA.—Much public interest has been aroused in the results of Dr. Koch's observations upon the cause of cholera, but we have been waiting to receive a definite account of what Dr. Koch has discovered, and what his conclusions concerning the matter are, before presenting the subject to our readers in this place. Dr. Koch's observations and conclusions are now published to the world, and although our space does not admit of a detailed account of his observations, we may briefly indicate their general character, and refer the reader to the *Deutsch. Medizin. Wochenschrift* for more complete information.

It appears that Dr. Koch has discovered an organism in the intestines of choleraic patients that he regards as a bacillus, but possibly it will turn out to be a spirillum, which, from its peculiar shape, has been designated as the comma bacillus. These bacilli, as far as observations have extended, are invariably associated with cholera. They are found within the glands, but especially between the epithelium and the basement membrane, where, by their active growth, they destroy the epithelium, and perhaps in this way give rise to the disease; or they may generate a specific poison which causes the disease. They are found most abundantly in the lower part of the intestine, and more or less abundant according to the severity of the attack. The comma bacillus is smaller than the bacillus of tubercle, but thicker in proportion and curved like a comma, but occasionally it assumes a double curve, like the letter, s. This is especially the case in cultures, when the bacilli grow in the shape of long,

delicate spirals, closely resembling the form of the spirochæte of relapsing fever. It grows within a considerable range of temperature, and is not killed by freezing. No resting stage has yet been observed. While ordinary bacilli form spores on drying, the comma bacillus is immediately killed by desiccation. Hence it follows that the disease is not likely to be disseminated by merchandise, but only by persons—possibly it may be carried by the wind for short distances.

The discovery of the bacillus affords an aid in the diagnosis of the disease, but no means has yet been discovered to destroy it when it once gains a foothold within the system.

While writing upon this subject we cannot omit a brief reference to an article in the *New York Medical Journal* of August 30th by Dr. John Bartlett, in which the author presents some bold speculations concerning the progress of cholera, and compares it with the advance of the army worm. The comparisons he makes are very forcible and telling. The subject has been well thought out, and no person who is interested in the study of contagious diseases should fail to read the article. The speculations concerning the dissemination of the cholera germs are scarcely in accord with our present knowledge of the comma bacillus, particularly as regards its inability to survive desiccation; nevertheless, the article is very suggestive, and affords suggestions worthy of careful consideration.

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FILAMENTOUS PROJECTIONS ON DIATOMS.—In an article in the June number of the *Journ. R. Micr. Soc.* Mr. J. Babcock, F. R. M. S., describes and figures certain filaments projecting from the frustules which cause movement of particles when the frustules pass near them, without apparent contact. Careful observation, however, reveals the presence of the straight filaments, which were observed on *Surirella bifrons*.



Several months ago—it was in November of last year if we are not mistaken—Mr. Henry Mills showed us some filamentous extensions from the beautiful discoid diatom, *Stephanodiscus Niagara*, found abundantly in the Great Lakes at certain seasons. The filaments were very numerous, and were doubtless quite similar to those described by Mr. Babcock. They were best seen when the diatoms were mounted dry and illuminated with a paraboloid. They have been observed by Mr. Mills for several years, and he states that they are only found at certain seasons of each year. If the reader will refer to page 8, Vol. III, of this JOURNAL, he will find there an account of the appearances described by Mr. Babcock. The significance of the filaments is unknown. It may be they are fungoid in their nature, but that seems very doubtful. On page 151 of Vol. I of this JOURNAL will be found an article by J. Brun, entitled 'Parasites on Diatoms,' in which it would appear the filaments described are mentioned as parasites, and the name *Leptothrix rigidula* is applied to them.

Our own observations, made upon the diatoms left by Mr. Mills in our possession, were quite superficial at the time, the specimen being set aside for future careful study. When we attempted to find the filaments at another time they had entirely disappeared, no preservative having been added to the liquid in the bottle. The subject deserves further study.

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 PHOTO-MICROGRAPHS OF BACILLUS.—M. Defrenne recently presented some photographic proofs before the Microscopical Society of Belgium, taken from a preparation of *Bacillus tuberculosis*, which were highly spoken of at the meeting. As is well known, it is exceedingly difficult to get reasonably good photographs of this minute organism, and few, if any, have succeeded in making photographs of it that were quite satisfactory. This is due, no doubt, to

the color of the stains applied. It might be supposed that a red anilin stain would serve the purpose well, but unfortunately it is known that such a color is far from satisfactory, as the light it transmits acts readily upon the sensitized plate.

The specimens used by M. Defrenne, however, were colored with fuchsin, and in the ordinary process of photographing they failed to yield satisfactory negatives. The idea then occurred to the experimenters to make use of a glass of complementary color to the red stain, placed between the objective and the sensitized plate. The presumption was that the rays forming the image on the sensitized plate would be filtered in passing through green glass, the red rays from the bacilli being if not wholly at least in great part absorbed. Thus the images of the bacilli would be black, while the green light would act upon the plate, and in this way decided contrasts would be obtained. The results verified the expectation, and good photographs were obtained.

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## NOTES.

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—Dr. C. S. Dolley, in an interesting communication to the Academy of Natural Sciences of Philadelphia, controverts the statements of Dr. A. Korotnoff concerning the presence of a large amœboid cell in the œsophagus and stomach of *Salpa*, having the functions of a digestive organ. He says:—

'*Salpa* has been very carefully studied by Hermann Fol, who demonstrated, by means of carmine suspended in water, that it threw out a constant stream of mucus when excited by the presence of nutritive material in the same water, with a reflex action like a salivary gland. The mucus is, by an arrangement of cilia, spread out like a curtain over the inner surface of the branchial sac, when it acts as a means for catching the food particles from the ingurgitated water. By the action of ciliary bands bordering the groove of the endostyle the mucus is swept towards the œsophagus, and as it approaches this it is, by means of the stiff cilia, on the sides of the gill, twisted into a thread and carried, by a continuation of

the aforesaid bordering bands, through the œsophagus into the stomach. Now, in studying a series of sections of a salpa which had had abundant food, we find as we approach the œsophagus a mass of material answering to the description of Korotnoff's "rhizopod." It takes staining readily, and may be traced backward into and through the œsophagus, stomach, and intestine. As the sections approach the rectum, however, the mass gradually ceases to take staining, and is much more distinctly marked out from the intestinal wall, having had all the organic matter digested out, and consisting only of the inorganic remains, which do not stain. The alimentary matter of salpæ is composed of animal and vegetal elements in nearly equal proportions, and the microscope reveals the calcareous shells of foraminifera, the beautifully sculptured frustules of diatomaceæ, keen siliceous needles, and the sharp armatures of minute crustacea.'

—The *Madras Times* publishes a letter from a correspondent who asserts that vaccination was practiced from a very early date by the Hindoo Vythians. There will be found an extract of a letter to the *Madras Courier*, dated January, 1819, which is as follows: 'Inoculation for the cow-pox was known of old time to the Hindoo medical writers. To substantiate this statement it is necessary only to refer to the *Sacteya Grantham*. In this work, after describing nine several species of the small-pox, of which three are declared incurable, the author proceeds to lay down the rules for the practice of inoculation. From this part the following extract is taken: "Take the fluid of the pock on the udder of a cow, or on the arm between the shoulder and elbow of a human subject, on the point of a lancet and lance with it the arm between the shoulder and elbow until blood appears; then, mixing the fluid with the blood, the fever of the small-pox will be produced." If further proof is required that long before the English came to India inoculation proper was practiced, a translation of a paper in the language of Orissa called Odiah, describing the manner in which the inhabitants of villages are inoculated by Odiah Brahmins, is given below: "A certain quantity of cotton to be wetted with the matter of a favorable small-pox, and from two hundred to four hundred people assembled on Sunday and Thursday, a cut to be given upon their arms with an instrument." Small-pox was accurately described by

Rhazes, an Arabian, about the year 900. It is supposed to have been introduced into Europe by the Saracens.'—*Medical Press*.

—Dr. Oliver Wendell Holmes has been making some calculations, through which the magnifying power of the achromatic microscope may be the more clearly conceived. Estimating from the extent to which it magnifies the minutest piece of human skin placed under its lens, the man of ordinary stature, proportionately enlarged throughout, would measure just one mile in height—ten times overtopping the loftiest of the pyramids and twenty times the tallest of our church spires. His weight would be sixty million tons, and he could take up the Massachusetts State House as he would a paving stone, and fling it into the waters beyond the Boston Light-house.—*Medical Age*.

—Dr. Frank L. James, in the *National Druggist*, gives the following method of preparing picro-carmine. The author is quite mistaken in supposing that formulas for preparing it are not readily available. On page 22 of the first volume of this JOURNAL is given an excellent method by Prof. Gage, and we still have a portion of the solution made at that time by Prof. Gage, which is as good now as when it was made:—

'Picro-carmine is one of the most valuable staining agents that the student of histology has at his command. The formula of preparing it, for some unaccountable reason, is not given in any of the standard works on the subject, and microscopists are forced to purchase it from dealers at exorbitant prices. The following is the process used in my laboratory for preparing a very satisfactory article: Dissolve 15 grains of the best carmine in the smallest quantity possible of stronger water of ammonia, and add distilled water enough to make one ounce of the solution. In a separate vessel dissolve 75 grains of picric acid in the smallest amount of boiling distilled water, making a saturated solution. When cold pour the two solutions together, and let stand in a closely-stoppered bottle for several days, giving it an occasional shake. At the expiration of four or five days filter the solution, and pour the filtrate into flat dishes; saucers or soup plates will do. Cover with a plate of glass close enough to keep out dust, but not so closely as to prevent evaporation. Put in a moderately warm place, and let stand until the fluid has entirely evaporated, leaving a



crop of fine brick-dust-red crystals. These should be collected, thoroughly dried, and preserved. When required for use, dissolve in about 50 times their weight of distilled water, filter the solution, and keep in glass-stoppered vials. Do not make more than an ounce of the solution at once, as a little of it goes a long way.'

—Photography with the microscope has become so popular among our readers that we doubt not many of them have found it troublesome to prepare the developer, and are often thereby deterred from making an exposure in the camera. A ready-mixed developer that will keep indefinitely will meet with a glad welcome from such persons, and we are glad to call attention once more to the pyro-developer prepared by Mr. Walmsley. It is an excellent combination for general use, and is always ready for instant use. It gives clear negatives, and if the exposures are not inordinately short for the plates used, they are free from color. Pyro-developers are more generally used in England than here, but they seem to be growing in favor. Mr. Walmsley has just returned from a trip abroad, and will hereafter keep a stock of dry plates from celebrated English manufacturers.

—Dr. Frank L. James, who conducts a microscopical column in the *National Druggist*, gives the following instructions for making a neutral-tint camera lucida:—

'It is merely a No. 2 three-quarter-inch round cover-glass inserted at an angle of forty-five degrees into a holder which embraces the rim of the eye-piece. Any person can make one in three minutes with a pill-box and a cover-glass. Procure a box that fits over the eye-piece snugly, cut a hole in the bottom the size of the front lens, and just below it make a horizontal slit a quarter or three-eighths inches long by driving a penknife blade through the bottom at an angle of forty-five degrees. Stick your cover-glass in this, and you have a neutral-tint camera lucida.'

—Mr. Woolman has recently received a series of mounted sections of rocks, which are probably as good as have been seen, if not even better than any heretofore placed upon the market. They are prepared by A. Hensoldt, London and Wetzlar, and compare favorably in price with those of inferior quality.

—Dr. D. E. Salmon, the chief of the Bureau of Animal Industry, has reported

a number of cases of contagious pleuropneumonia among cattle in the West. This is a disease which may well cause alarm among stock-raisers, and although there is reason to fear it has already been extensively diffused, it is encouraging to notice the prompt action of the authorities of different States to prevent its further progress. Dr. Salmon is now in Chicago, where he is laboring hard to stamp out the disease, in which, we trust, he will be successful.

—Mr. G. D. Julien offers sections of rocks, minerals, fossils, etc., in our advertising columns which are undoubtedly excellent. We say this much without having seen them, but with the facilities for preparing them at the School of Mines, where Mr. A. A. Julien has prepared many hundred sections for study, there is no reason why specimens of the best quality should not be prepared for the use of microscopists generally.

—A committee of the A. A. A. S. was appointed at the Philadelphia meeting to endeavor to secure Government aid in the investigation of fungoid diseases. The subject is one well worthy of liberal assistance, and its importance need not be urged. Few persons realize, however, the necessity of assistance, and it is hoped the committee will clearly set forth the difficulties which interfere with, and almost entirely prevent, the carrying out of private investigations in this direction. The work is of peculiar difficulty, requiring constant attention on the part of the observer, and it is not only necessary to have special laboratories properly furnished for it, but skilful and experienced observers must be engaged, who can give their entire attention to the work. We shall watch with interest the efforts of the committee. Their efforts should be crowned with success, for even the public at large now manifests such an interest in the observations of microscopists upon the causes of disease that it may reasonably be supposed Congressmen will easily be convinced of the importance of the work.

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## CORRESPONDENCE.

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### A Long Worm in a Grasshopper.

TO THE EDITOR:—Recently, while dissecting a grasshopper, I discovered within its body a worm, evidently parasitic, which, after being removed and unfolded, measured twenty-one and one-half inches in

length. The worm, when dropped into a cup of water, exhibited vigorous life throughout its entire length. It is about  $\frac{1}{4}$  of an inch in diameter, white, ringed, and tapers at each extremity like the earthworm. The grasshopper, when captured, seemed to be in normal physical condition. If any of your readers have ever found so large a living creature domiciled in so small a tenement, I would be pleased to hear from them.

EDWARD G. DAY.

RIVERSIDE, Conn.

## NOTICES OF BOOKS.

*The Formation of Poisons by Micro-Organisms.* A Biological Study of the Germ Theory of Disease. By G. V. Black, M. D., D. D. S. Philadelphia: P. Blakiston, Son & Co., No. 1012 Walnut Street. 1884. (pp. 178. Cloth, \$1.50.)

This volume contains a series of lectures delivered before the Chicago College of Dental Surgery. The first part begins with a study of the germ theory of disease, in which the author displays considerable familiarity with the literature of the subject. Evidence in support of the germ theory is briefly given, the nature of miasm and contagion is discussed, the views of different recognized authorities are concisely stated, and the results and evidence are finally summed up in the third lecture, which concludes the first part.

The second part, the author says in his preface, 'was written because I had something to say that I thought ought to be said at the present time.' It begins with a lecture on the Relation of Micro-Organisms to the Production of Disease. The author holds to the view that the organisms of disease produce poisonous compounds in the body, and in this way become the cause of disease. He goes on to consider the physiological phenomena of life at length, considering especially the action of ferments in digestion, and finally the production of alkaloids in the system and the growth of bacteria. The seventh and last lecture treats of poisons, and particularly the poisons produced by micro-organisms. So little is yet known about this subject it is scarcely possible that the author could reach any very positive conclusions. It is principally a matter of conjecture how the organisms of disease act upon the system. The book is well worth reading as a good summary

of the arguments in support of the views set forth.

In the Appendix is a chapter on Dental Caries and its relations to the germ theory of disease, in which the view is taken that there is a kind of ferment formed which, as we understand the matter, may or may not be the product of micro-organisms, but frequently associated with them, which destroys the teeth.

*Microscopic Observations.* By Thomas Taylor, M. D. Internal Parasites in Domestic Fowls and Butter and Fats. Washington: Government Printing Office. 1884.

This is a small pamphlet of seven pages and one colored plate, illustrating the appearance of different fats under polarized light. Those who are interested in the subject would do well to write to Dr. Taylor for a copy of the pamphlet.

*How to Grow Fine Celery.* A new method. By Mrs. H. M. Crider. York, Pa.: H. M. Crider, publisher. 1884. (Pamphlet, pp. 16. Price, 25 cents.)

## Exchanges.

[Exchanges are inserted in this column without charge. They will be strictly limited to mounted objects, and material for mounting.]

Echinus spines of various species offered to any person who will send in return three good sections of the same.

Box 630, Washington, D. C.

Wanted.—Diatoms on seaweeds and in muds, from all the tropic seas. Offered a large quantity of fine selected diatoms and other slides, or cash.

J. C. RINNBLOCK,  
14 Simmering, Wien, Austria.

Will exchange well mounted slides for others well mounted.

H. H. PEASE,  
1271 Broadway, N. Y.

Slides of fresh water algae, desmids, bacteria, infusoria, &c., for good pathological or other interesting slides. Lists exchanged.

J. M. ADAMS,  
Watertown, N. Y.

Material for mounting of all kinds wanted in exchange for other first-class unmounted objects in great variety.

M. A. BOOTH,  
Long Meadow, Mass.

Will exchange very thinly cut and well-stained histological and pathological slides for other histological and pathological slides. Will also exchange a limited number of histological for other slides of various kinds.

H. L. WHITNEY, M. D.,  
German Hospital, Girard ave. and 21st St.,  
Philadelphia, Pa.

Will exchange good slides of micro-fungi, various Diatoms *in situ* on algae, chemical crystals, and a fine selection of stellate hairs on leaves of plants, for other good slides.

JAS. E. WHITNEY,  
Rochester, N. Y.



# THE AMERICAN MONTHLY MICROSCOPICAL JOURNAL.

VOL. V.

WASHINGTON, D. C., OCTOBER, 1884.

No. 10.

## The American Association—Section G, Address of the Vice-President.

The section of microscopy and histology of the American Association, at the meeting in Philadelphia last month, although not large in number of members, was well provided with papers of scientific interest. The number of papers was, indeed, less than were presented before other sections, as it must always be, for obvious reasons.

There were present at some of the meetings the Rev. W. H. Dallinger, Mr. James Glaishier, and Mr. I. C. Thompson, of England.

In the absence of the Vice-President, Prof. T. G. Wormley, the Rev. A. B. Hervey was called to preside at the first meeting, on Thursday, September 4th, and necessary business of organization was transacted.

### PROF. WORMLEY'S ADDRESS.

In the afternoon Prof. Wormley delivered the Vice-President's address. The address was not written, and we give, from notes taken during its delivery, the only abstract that has been published.

The subject was the applications of the microscope in chemical and micrometric observations. The microscope, he said, frequently enables us to determine in a moment questions which, without its aid, would require hours and days. Thus: If a piece of bright copper be placed in an acid solution containing arsenic and heated, the copper becomes coated with a dark deposit. This is common to several metals; but if the copper strip be then placed in a small tube

and heated, the arsenic will be sublimed, and will condense in the cool part of the tube in minute octahedral crystals, which may be recognized with a microscope. If the copper be coated with mercury, opaque microscopic globules of that metal will be found in the sublimate. Quantities of metals, alkaloids, etc., much smaller than can be detected by chemical tests, can be discovered in this way. Of the two metals mentioned,  $\frac{1}{100000}$  of a grain of either of them can be recognized. As further illustrating the delicacy of microscopic tests, the alkaloid atropine may be mentioned. With bromine and bromhydric acid this substance yields peculiar crystals, which are characteristic in quantities of  $\frac{1}{25000}$  of a grain.

Another important application of the microscope is in the identification of blood in stains, etc. The results of extended observations by the speaker relative to this subject will soon be published. The question presented to a microscopist when called upon to examine a stain may be in one of three forms, viz: 1. Is it or is it not blood? 2. It is admitted to be blood, but what kind of blood? 3. It is admitted to be blood, and asserted to be blood of a mammal.

In the first instance the presence of blood can be recognized by the corpuscles. Serious mistakes have been made by persons who have been deceived by finding spores which they regarded as blood-cells. Three instances of this nature have occurred in this country within a few years. Such mistakes are not necessary, as it is always possible to distinguish

blood-corpuscles. It may be claimed that the blood is that of a fowl. The form of the corpuscles will distinguish them from those of mammalian blood, but the corpuscles of cyclostomous fishes are circular.

In the second form of the question it becomes necessary to discriminate, if possible, between the blood of different mammals, especially to distinguish human blood from all other kinds. Some say this is possible, others that it is not. The discrimination depends upon the difference in size of the corpuscles and our ability to take cognizance of slight differences of this kind.

The speaker then discussed in an interesting manner the subject of minute measurements. The naked eye readily divides a space of  $\frac{1}{100}$  of an inch into four parts. The oval blood-disks of *Amphiumas* measure  $\frac{1}{400} \times \frac{1}{800}$  of an inch, and the naked eye readily notices the oval shape. But assuming  $\frac{1}{100}$  of an inch as the limit of measurement with the naked eye, with a magnification of ten diameters the eye could measure  $\frac{1}{100} \times 10$  or  $\frac{1}{1000}$  of an inch with the same ease, or  $\frac{1}{10000}$  with a power of 100 or  $\frac{1}{100000}$  with a magnification of 1,000.

In measuring, the speaker prefers a Jackson eye-piece micrometer, and with this he finds  $\frac{1}{1000}$  of an inch equivalent to 20 spaces of the eye-piece scale. Each space, therefore, represents  $\frac{1}{20000}$  of an inch, and since a trained observer can readily divide the single spaces of the eye-piece into tenths, it is possible to measure the  $\frac{1}{200000}$  of an inch, and by further magnification this limit may be reduced to  $\frac{1}{2000000}$  of an inch.

The difference in size of blood corpuscles is considerable; in the elephant they measure  $\frac{1}{2000}$ -inch, in the musk-deer  $\frac{1}{12000}$ . Blood-cells from some different animals have the same size. The corpuscles of human blood and those of several animals have practically the same dimensions. Those of the opossum, for instance, are about identical in size. Hence

the microscope does not enable us to distinguish human blood in every case. The blood of the ox, which measures  $\frac{1}{4000}$ -inch, can be distinguished from human blood by the difference in size. It has been observed that the blood-cells may become smaller than the normal size, but they never increase beyond it.

As regards the examination of blood-stains, it has been found that the corpuscles may be restored to their normal size after years of dessiccation by digestion in fluids. The abnormal corpuscles are not likely to be restored. For this purpose the speaker prefers pure water alone. Some years ago a 33 per cent. solution of potash was recommended. Water is now used, and the results are surprising.

The diameter of dog's blood-corpuscles has been observed to be uniformly  $\frac{1}{35000}$  of an inch, although prominent authorities have maintained that there was no difference between them and those of human blood.

At the conclusion of the address the Secretary inquired if drying affected the size of the cells, as had been asserted by some writers. In reply the speaker said he had never found any appreciable difference between the cells measured in the serum and when dried on a slide. The best method of spreading the blood on a slide for mounting was that of Prof. Johnson. A drop of blood is placed on a slide and spread by drawing over it the edge of a second slide inclined. The smaller corpuscles to be observed in this way are abnormal ones, seldom found in the serum.

In response to a question by Mr. Hyatt, it was said that the size of red corpuscles was not changed by diseases.

The range in size of human blood-cells was stated to be  $\frac{1}{35000}$  to  $\frac{1}{30000}$  of an inch.

On succeeding pages will be found abstracts of the various papers read, with the exception of three, of which satisfactory abstracts cannot well be



prepared. These are entitled 'Some New Microscopical Devices,' by Dr. R. H. Ward; 'Description of the Schröder Camera Lucida,' by R. Hitchcock; 'Demonstration of Perforations in the Cellulose Walls of Plant-cells,' by Dr. Louis Elsbery. In addition to these a paper was announced by Prof. W. A. Rogers 'On the Reproduction of Short Standards of Length,' which was not read. Mr. W. H. Walmsley showed a method of using the electric light in microscopical work. He had a fine Beck's microscope fitted with incandescent lamps of small size above and below the stage, in which the strength of the light could be perfectly regulated.

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### Celloidine as an Embedding Mass.\*

BY PROF. WILLIAM LIBBEY, JR.

Celloidine is a pure form of pyroxiline manufactured by a patented process in Germany, and used largely in photography in place of collodion, and also for embedding purposes in histology. It is prepared by dissolving 1 ounce of celloidine in ether, noting the quantity of ether used, and when dissolved an equal quantity of absolute alcohol is added. Two solutions are needed, one very thin and the other thick.

The specimens, after being properly handled, are then soaked in absolute alcohol for an hour or two, then for the same period in strong ether, then for six hours in the thin solution and for the same time in the thick solution.

A good cork must also be soaked in some absolute alcohol, and when ready to embed, this cork is taken and a small quantity of the thick solution placed on one end of it and allowed to dry until it is well stiffened. Then the specimen, with as much of the thick solution as will adhere to it, is placed on this and allowed to dry partially, when another coating is

placed over the specimen from the same solution, and this proceeding ought to be repeated until the specimen has a sufficient quantity around it to hold it firmly; then it is allowed to dry and when stiff is placed in 80 per cent. alcohol for 12 hours at least before cutting.

The sections are best cut in alcohol and preserved in it until wanted. They can be stained as they are in the mass as it does not stain readily, and then mounted, but they must be cleared up in oil of cedar or origanum, as the oil of cloves usually used dissolves the mass.

Where it is important to keep parts of the section in their relative positions the above method of procedure is best, but where it is of no importance the mass can be removed perfectly by soaking first in absolute alcohol, then in ether for a few moments, and then putting them in alcohol again or in a mixture of equal parts of alcohol, glycerin, and water where they will keep indefinitely.

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### Methods of Cultivating Micro-Organisms.\*

BY GEORGE M. STERNBERG, M. D.,  
F. R. M. S., MAJOR AND SUR-  
GEON, U. S. ARMY.

That branch of biological research which relates to the lowest and smallest of living organisms, the bacteria, or schizomycetes, is second in importance to none other, either from a purely scientific or from a practical point of view; for these lowly plants, in their morphology, growth, and reproduction, present to us the simplest possible conditions for the study of fundamental biological problems, and they offer peculiar advantages for the prosecution of experimental researches bearing upon these problems, by reason of their rapid multiplication and the facility with which species may be isolated and 'pure cultures'

\* Abstract. Read before Section G, A. A. A. S.

\* Abstract. Read before Section G, A. A. A. S.

maintained through many successive generations.

By means of these pure cultures we are enabled to study the modifying influences of environment upon form or function, the influence upon growth and reproduction of various chemical substances, of different degrees of temperature, etc.

It is only necessary to mention the brilliant discoveries of Pasteur and of Koch relating to the rôle of these minute plants in various processes of decomposition and in the etiology of infectious diseases, in order to call attention to the practical results which these researches promise.

Without doubt the very great accessions to our knowledge in this direction which have been made during the past few years are largely due to improvements in technique relating to the recognition (by staining reagents, special modes of illumination, etc.) and cultivation of the micro-organisms in question.

In a paper read at the Cincinnati meeting of this Association, in 1881, a detailed account was given of the writer's method of conducting culture experiments. Further experience has fully confirmed my conviction that the method referred to has advantages over all others for cultivating micro-organisms in fluid media, and my object at present is to give a practical demonstration by which the advantages claimed will be made apparent, rather than to add anything to the technical account of my mode of operating. At the same time I shall call attention to the invaluable method of surface cultivation, which is so highly recommended by Koch, and which has been published by him since the reading of my paper above referred to.

The special advantages of each method will be pointed out, not with a view to showing that one is superior to the other, but in order to indicate the particular cases in which one or the other is preferable, for neither can entirely take the place of the other ;

and if a pure culture may be more easily maintained in an hermetically sealed flask, it is unquestionably true that the method of Koch has added greatly to our resources for the isolation and naked-eye recognition of the innumerable species of bacteria which surround us on every side, which infest the water we drink, the air we breathe, and, as harmless parasites, the human mouth and intestine in countless hosts and of many different forms.

It is only by resorting to some method by which we are able to secure and maintain 'pure cultures' that we are able to obtain a precise knowledge of this extensive microscopic flora, for in nature the species are mingled together in such a way that nothing but confusion and uncertainty can come from the attempt to establish species upon morphological characters alone.

There is nothing novel in the form or construction of the little flasks which are used in the method which I recommend to you. They have, no doubt, been used occasionally by other experimenters for various purposes prior to my calling attention to their special advantages for the purpose in view. These advantages are best secured by making the flasks of moderate size, and by drawing out the neck into a slender capillary tube, so that the mode of manipulation which I shall demonstrate becomes practicable. The method, taken as a whole, is original, and, so far as I know, had not been practised by any one prior to the publication of my paper referred to. The usual method has been to use open-mouthed flasks or test-tubes, into which a sterilized culture-fluid is introduced, and from which atmospheric germs are excluded by a sterilized plug of cotton-wool. In skilful hands this method gives satisfactory results, but it requires much time and care, and the most experienced manipulators cannot avoid the occasional contamination of a culture, or the 'breaking



down' of a stock solution. Even if such accidents were not of common occurrence, the method I recommend would be preferable on the score of economy of time and material and of ease of manipulation. The advantages claimed, briefly stated, are as follows:—

The small flasks employed are made in the laboratory, from glass tubing, very expeditiously and at small expense.

Each flask contains a sufficient amount of nutrient fluid and of oxygen to insure a vigorous and abundant development of any aërotic micro-organism introduced as seed. The bacilli readily form spores in these flasks.

When properly sterilized the enclosed culture-medium remains unchanged indefinitely, and the little flasks, ready for use at a moment's notice, may be packed away in drawers or boxes for years, if desired, and may be conveniently transported from place to place.

The inoculation of one flask with micro-organisms contained in another, or with a drop of blood from the veins of a living animal, etc., etc., is effected expeditiously and with perfect security from contamination by atmospheric germs.

Small amounts of fluid may at any time be withdrawn from one of these flasks for microscopic examination without the slightest danger of introducing foreign organisms, and thus destroying the purity of the culture.

Finally, these little flasks take the place of a syringe when an inoculation experiment is to be performed, the contents being forced beneath the skin, or into one of the cavities of a living animal, by applying gentle heat to the bulb, thus causing the enclosed air to expand, and forcing the fluid contents through the capillary neck of the flask.

The method having been described in detail in my paper already referred to (see report A. A. A. S. for 1881) my principal object at present is to

give a practical demonstration of its advantages over other methods of cultivating micro-organisms in fluid media.

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### Remarks on Fluid and Gelatinous Media for Cultivating Micro-organisms, with Description of Salmon's New Culture-tube and Demonstration of the Process of using it.

The above was the title of a paper read by the Editor of this JOURNAL, but written at his request by Mr. Theobald Smith, the assistant of Dr. Salmon in his laboratory. A cut showing the construction of the tube will be given, if possible, next month. The paper was as follows:—

Much has been said of late concerning the advantages of a solid substratum over a liquid medium in the culture of the Schizomycètes or so-called bacteria. This is no doubt due to its very successful employment by Dr. Koch in the study of tuberculosis, and more recently of cholera, and his own oft-repeated statements as to its superiority. He has, however, employed liquid media for his cultures of the tubercle-bacillus, and is now studying the comma-bacillus in a decoction of meat. In fact, he says that it flourishes best in fluids which do not contain too little nutrient material. (See *Deutsche Med. Wochenschrift*, 1884, p. 503.)

Many bacteria naturally live in fluids, such as the blood in case of disease, in stagnant water, etc. The life-history of such forms can never be traced completely without resorting to liquid cultures, approximating in physical and chemical properties the natural medium of the microphytes. Thus, the swarming stage of bacteria can only assert itself in a fluid, and the peculiarity of many species to collect in the form of a membrane on the surface of liquids at a certain period of their life can express itself only very indirectly or not at all upon a layer of gelatin or blood serum.

Though we must regard as an excellent addition in the study of bacteria the more rigorous technique of the present method of solid substrata, especially in its application to the isolation of different forms, it can never supplant liquid cultures, and therefore any apparatus which will materially simplify the laborious and minute technique and reduce to a minimum the sources of error connected with the study of microscopic fungi in liquid media must be hailed as an important and lasting step in advance. The culture-tube devised by Dr. D. E. Salmon has certainly proved to be such. Though in constant use for over a year in his laboratory, Dr. Salmon has not yet found the opportunity of publishing an account of it, and owing to the pressure of official duties his appearance at this meeting is impossible. I shall, therefore, take the liberty of pointing out, in the briefest manner, the construction and use of the culture-tube, with the hope that he will present a more extended description at a later date.

The culture-tube consists of a test-tube-like body or reservoir, of rather heavy glass, about 4 to 5 inches in length and three-fourths of an inch in internal diameter. Over the top of this reservoir a second hollow piece is fitted, which might be called a cap. Its internal surface is ground to fit snugly over the ground external surface of the upper end of the reservoir, thus forming a ground-joint union. This cap, about  $2\frac{1}{2}$  inches long, abruptly contracts near its middle into a narrow tube with an internal diameter of about  $\frac{3}{8}$  of an inch. The third piece, which might be called the ventilating tube, is shaped like an inverted  $\nabla$ , one limb being about 3 inches long, and  $1\frac{1}{2}$  inches longer than the limb which fits by means of a ground joint over the narrow tube of the cap. The longer, free limb of the ventilating tube lodges a plug of glass-wool from  $1\frac{1}{2}$  to 2 inches long. The limbs of the ventilating-tube are about one inch apart.

The culture-liquid is introduced by removing the cap, which brings with it the ventilating-tube, and it is sterilised in the tube. The liquid is inoculated by removing the ventilating tube only. To prevent the ground joints from sticking too firmly, a little sublimated vaseline is introduced between the surfaces of the joint.

The pipette, used to introduce a drop of fluid containing bacteria, consists of an ordinary glass tube about  $\frac{1}{4}$  of an inch in diameter and 2 to 3 inches long, one end of which is drawn out into a very fine, almost capillary tube, which must be long enough to easily reach the bottom of the reservoir when introduced through the narrow tube of the cap. A plug of glass-wool occupies the other end, which is closed by a rubber ball.

The method of inoculating the culture-liquid is briefly as follows:—

The pipette is first thoroughly sterilised by flaming every portion of it from the tip of the capillary tube to near the rubber bulb until the contained air is subjected to a temperature of at least  $150^{\circ}$  c. We usually bring it to a dull red heat, avoiding the contingency of melting the capillary tube. It is hung with the rubber bulb up to avoid its capillary portion coming in contact with anything while cooling. When sufficiently cool the capillary portion is again drawn once or twice through the flame to destroy any particles that may have become attached meanwhile. The ventilator of the culture-tube, containing the bacteria to be sown, is flamed and removed and the narrow tube of the cap flamed, the rubber bulb slightly compressed, and the pipette introduced, a few drops drawn up, the pipette slowly withdrawn, the cap flamed again, and the ventilator replaced. The cap of the fresh tube is now flamed before and after removing the ventilator, the pipette introduced, a drop allowed to fall into the culture-liquid, the pipette removed, the narrow tube of the cap again flamed, and the ventilator replaced. This is the



procedure of obtaining a pure culture from one preceding. When the source of the bacteria is an exudate, or the flow of the animal body, various methods are in use. The method above given may, however, be employed in most cases.

The success of the work depends as much upon the worker as upon the apparatus employed. A bungling manipulation may cause failure with the best method. The personal equation in this as in many other fields of research is necessarily an important factor. Many minute details, which may seem too trivial to be mentioned, are slowly acquired, and gradually help to increase the percentage of absolute success.

It is evident that the reservoir may be variously modified. A flask-shaped body may be used for cultures that require an abundance of air, but the test-tube form will serve nearly all purposes. It enables the nature of the opacity in the liquid to be readily determined, while the earliest traces of a membrane or a deposit are more easily detected than with a broad body and a flat bottom. The microscopic appearance of these features, in case of many forms, will enable the experienced observer to foretell whether the culture is pure or contaminated.

The culture-tube, then, recommends itself as a simple, very neat apparatus, readily filled, sterilised, and inoculated. It dispenses with the troublesome and dangerous expedients of disturbing cotton plugs, and of tying down various air-filtering materials. It is easily cleaned, and hence may be used over and over again, the original cost of the tube being in this way reduced to a minimum in the end. It does not break readily, nor are there any sharp or jagged edges to be feared in the manipulation of dangerous cultures. It is very compact, and occupies but very little space in a thermostat. Finally, the chances of contamination through the air during the process of

inoculation are practically of no account. We have not yet seen an impure culture derived from a preceding pure culture during the period of our experience with these tubes. It is becoming more and more the conviction of careful investigators—and Brefeld, in describing his method, emphasizes it—that in a room where dust is carefully managed a short exposure to the air is not dangerous. The utensils used, upon which particles are continually being deposited, unless thoroughly sterilised, are the chief carriers of a miscellaneous contamination.



### Histology of *Lingula*.\*

BY H. G. BEYER, SURGEON, U. S. N.

It was only after considerable hesitation that I finally concluded, in a conversation with our esteemed secretary, Mr. Hitchcock, a few days ago, to venture making a few remarks on this subject, the pressure of my legitimate duties as naval medical officer having frequently interrupted my studies, and preventing me from presenting a more complete account, at least at present. I will, therefore, confine my remarks on those most interesting little organs called hearts, or oviducts, or also segmental organs. These organs have attracted no little attention and interest on the part of the most distinguished anatomists ever since the time they first turned their attention to the study of the anatomy of the brachiopods in general.

Before the time when Hancock wrote his classical essay on the organization of the brachiopoda in the *Phil. Trans.* of 1858, these organs had been described as hearts. Mr. Hancock, in the article referred to, says: 'Four years ago I had occasion to dissect *Woldheimia Australis*, *Terebratulina caput serpentis*, and *Lingula anatina*, and was then struck with the peculiar appearance

of the organs denominated hearts by Baron, Cuvier, and Prof. Owen, all subsequent writers on the subject.

'These so-called hearts seemed to me very unlike any molluscan heart that had ever come under my observation, and on attentive examination it became evident that they give off no arteries, as they had been described to do; and, moreover, that their apices, from which the arteries were stated to pass off, appeared to open externally. For these and other reasons I was inclined to disbelieve in their cardiac nature, and to regard them rather as oviducts.'

Hancock also discovered the true hearts, situated above the stomach, and two secondary pulsatile vesicles, situated somewhat posteriorly to the true heart.

These hearts, oviducts, or segmental organs (as they were called by Prof. E. S. Morse, who compared them to the segmental organs of annelids) are generally described as having two openings—one a small one externally, and another, large and funnel-shaped, opening in the perivisceral cavity.

I have brought with me a series of sections, by means of which I hope to show you that, although the opening to the exterior is very clear and manifest, the internal opening is not of so simple a nature as has hitherto been described. I find that the internal end is in very close relation and probable direct communication with the interior of a convoluted tubule or glandular sort of vesicle. These vesicles, two in number, are found on the looped portion of the alimentary canal, and, so far as I am aware, and from what I have been able to gather from some of the plates accompanying the article by Mr. Albany Hancock, above referred to, correspond somewhat in situation to his pulsatile, secondary vesicles. On closer examination a communication was found to exist between these pulsatile vesicles and one of the diverticula of the alimentary canal, so that we have here

an indirect communication between these oviducts and the lower portion of the alimentary canal. Until further and more extensive studies shall have been made on other brachiopods I shall abstain from entering into a discussion on the morphological significance of these findings. The specimens which I have brought with me to-day will, I hope, be sufficiently convincing, at least so far as *lingula* is concerned. I shall present a more detailed account of the histology of *lingula* at some future nor very distant day. To-day I am obliged to limit myself to this brief and fragmentary account.

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### Upon a Microscopical Method of Studying the Amphibian Brain.\*

BY HENRY F. OSBORNE.

The brain is hardened in bichromate of potash (Müller's fluid) the ventricles being fully injected. After the usual alcohol treatment, the brain is placed for one week in carmine solution; then for 24 hours in acetic acid.

The imbedding mass is prepared by shaking the contents of an egg with three drops of glycerin. After soaking in this mass the brain is placed in position, and hardened in the vapor of boiling alcohol spirit, 80 per cent. The mass is then placed one week in absolute alcohol.

The cutting is done with Jung's microtome; 50 or 60 sections collecting on the razor in alcohol are then floated at once, in order, upon the slide. To keep them in place they are covered with thin blotting-paper during alcohol and oil of cloves treatment. This is removed and the sections mounted in the usual way.

The section glasses, and then the sections showing particular structures, are then indexed.

\* Abstract. Read before Section G, A. A. A. S.



## An Immersion-Apparatus for the Determination of the Temperature of the Critical Point in the Fluid Cavities of Minerals.\*

BY ALEXIS A. JULIEN.

In a former paper, read before the American Chemical Society, and published in vol. iii. of its Journal, I have discussed the subject of the examination of carbon dioxide in the fluid cavities of the white topaz of Minas Geraes, Brazil, and took occasion to sum up the known occurrences of carbon dioxide in fluid enclosures of the rocks and veinstones of this country, so far as detected up to that time. The substance has been unfamiliar even to many chemists, and its occurrence in nature was considered rare, even by most geologists; but nineteen localities on this continent were then referred to, as determined by Messrs. G. W. Hawes, F. Zirkel, A. Wichmann, R. D. Irving, A. W. Wright, and, in four localities, by myself.

Reference was made to the various forms of stage-heating apparatus employed by observers to produce in one of these minute cavities of a mineral while under observation through the microscope, the rapid and extensive dilatation of the enclosed floating bubble or sudden vaporization of the liquid, by which the identification of carbon dioxide is easily effected, and to determine accurately the temperature at which this action takes place. This temperature may be very low, such as the radiation of a burning cigar, or of a warm metal rod, a jet of hot air, or of the warm breath conveyed through a rubber tube, or even of the tip of one's finger ( $37^{\circ}\text{C.}$ ) applied to the bottom of a thin slide, while resting upon the stage of the microscope, if the mineral section is also very thin. But the exact determination of the temperature at which the bubble or liquid disappears requires a special apparatus, of which several forms have been devised,

which may be thus classed according to the thermal agency employed:—

1. A continuous current of hot air conveyed horizontally through a metal chimney beneath the thin section and the adjacent bulb of a thermometer; as in the several devices of Nachet, Beale, and Fuess.

2. A similar current of hot water conveyed between the stage and the slide and thermometer, through a metal conduit from a small adjacent tank or boiler; as in the apparatus of Polallion, Ranvier, etc.

3. A conveyance of heat to the thin section and thermometer by conduction through a metal plate, preferably brass or copper, projecting beyond the stage over the flames of tapers; as arranged in the forms proposed by Chevalier, Dujardin, Ransom, and Schultze. (See Frey 'The Microscope.')

4. The conduction of heat derived from a galvanic current under the control of a rheostat, through a fine platinum wire bent back and forth over a ring-shaped thermometer bulb, upon which the slide is supported. This is the apparatus proposed by Vogelsang, fully described in most works on general lithology, as those of Zirkel, Rosenbusch, and Lasaulx, and even yet in common use.

The objection to all these forms of apparatus lies in their irregular application of heat, and its irregular and indefinite loss from currents in the surrounding atmosphere, and from the refrigerating effect of the mass of metal in the stage, and also in the microscope objective, in an amount proportionate to its close approximation, *i. e.*, to its focal distance or high power. Even in the most pretentious apparatus, that of Vogelsang, its inventor admits a variation or error of  $10^{\circ}\text{C.}$ , according to the objective employed; from a No. 4 Hartnack of 3 mm. focal distance to a No. 9 of 0.1 mm.

Vogelsang suggested the reduction of observations made by means of high-power objectives to the standard of the No. 4, and even was forced to

\* Abstract. Read before Section G, A. A. A. S.

make a plus correction of one degree (centigrade) for observations in which the temperature of the air of the room and of the microscope fell below his normal ( $20^{\circ}$  c.) as far as  $12$  to  $15^{\circ}$ . Practically, in use these observations are consequently made almost altogether on large cavities and under low-power objectives, and an accuracy to one degree centigrade has been accepted as satisfactory. Although wide discrepancies have constantly occurred, even in determinations on the fluid cavities in the same slice of mineral by means of these devices, on the other hand some of the most delicate and important investigations, such as those of Sorby and King on the indication of the degrees of pressure to which certain granites have been subjected during folding and metamorphism, have rested largely upon the accuracy of determinations of this very kind.

In my previous paper I have described two forms of apparatus founded on the plan of immersion of both the objective and the thin section under examination in baths which may be warmed sufficiently by the direct application of the flame of a taper, or by conduction through a copper plate, or by the slow addition of water of a different temperature, or, in a warm room, by a current of the observer's breath. All interference with the investigation, either by warm or cool atmospheric currents, or by radiation into or from adjacent metal, is eliminated by this plan. I afterwards found that the suggestion of the idea of immersion of the thin section alone had already occurred to Brewster, Vogelsang and Sorby, who had in occasional single investigations simply immersed the mineral in heated water or glycerin, stirring up the liquid with a thermometer. The range of error found in this partial application of the idea amounted to  $13^{\circ}$  c., even with low-power objectives; the process was found tedious and slow, and Vogelsang preferred the use of his galvanic apparatus.

In place of the two forms of apparatus described in my former paper, I now present a more finished arrangement, consisting of a thin-walled box heated by conduction from a taper through the copper plate which forms its bottom and projects beyond the stage. The thermometer, made to order by the well known instrument maker to the Smithsonian—Mr. Henry Green, of New-York—has a scale ranging little beyond  $22-45^{\circ}$  c., each degree on the scale being two cm. in length and divided into tenths. The bore and length of the tube is so arranged as to bring that part of the scale near  $30^{\circ}$  c. on a level with the eye, while stationed at the eye-piece, to facilitate an instantaneous observation, by a glance, of the height of the mercurial column, at any moment, without a removal or even movement of the head. I find as before that not only the high-power immersion objectives, such as the  $\frac{1}{8}$  of Spencer or  $\frac{1}{4}$  of Powell and Lealand, can be used in this way, but that apparently any low-power objectives so far tried have their fittings water-tight, and can be used while half immersed in the bath, only occasionally with a little loss of definition or brightness, sometimes with a decided improvement in both qualities and with a complete dispensation of the necessity for repeated refocussing otherwise required. The observation of the critical point in the fluid, checked by both the temperatures of disappearance and reappearance of the bubble, may be easily effected in most cases within ten minutes and to an accuracy of at least one-twentieth of a degree centigrade. For various further particulars and precautions, I need but refer to my former paper.

### On Some Points in Microtomy.\*

BY JOHN A. RYDER, EMBRYOLOGIST  
TO THE U. S. FISH COMMISSION.

The attention of investigators has been so greatly occupied with this

\* Abstract of paper announced for Section G, A. A. A. S., but not read.



subject within a very recent period, that it may be said that a new art has been developed which we may call microtomy.

In working with vertebrate materials hardening and killing should be done in such a way as not to distort the axis of the embryos, in order that the knife and microtome may be adjusted so as to cut in any desired plane with accuracy. The embedding must be as homogeneous as possible; for this purpose saturating the object with paraffin has been found to be the best, so that evenly thin sections may be produced. The methods of Bütschli, Plateau, Calberta, Duvall, all serve this purpose, and their relative values are probably expressed in about the order in which they stand. Staining is best accomplished in embryological work by dyeing the object as a whole; this saves time and may be done in a number of ways. Mounting should be done serially and with the ribbon method; where hard paraffin is used, the sections are rapidly and easily laid on the slide with needles in neat order, if the fixing is done with a compound of clove oil 3 volumes and collodion 1 volume, which is thinly painted on the slide, and on which the sections are carefully laid, when the slide may be gently warmed for a minute; this melts the paraffin in the sections, the clove oil is driven off, and the sections fixed by the collodion, when a few drops of turpentine will immediately dissolve and remove the included and adherent paraffin, when the mounting may be done under an oblong cover in balsam.

These methods enable the student to interpret the structure of an organic body in three dimensions, and so great an accuracy of preparation is thus attainable that enlarged models are easily made from super-imposed card or wax plates joined together and cut from outlines drawn by the help of the cameralucida from the successive sections enlarged to a common scale; or it is even possible in

the same manner to construct stereograms by drawing camera outlines one upon the other, for the reason that if the sections are properly prepared, every part will be in its proper place and the final result will be accurate. In this way I have built up views of embryo fish crania in perspective from one side; cartilaginous crania, which it would be utterly impossible to clean on account of their small size, so as to make an entirely serviceable preparation, because ordinary methods of preparing would inevitably show important parts out of place and render the object unreliable for the purpose of illustration.

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### **Recent Studies on the Theory of the Microscope and their Practical Results as Regards the Use of the Microscope in Scientific Investigations.\***

Few who are not constant readers of the literature pertaining to the physics of the microscope are aware of the great advances that have been made in the knowledge of the microscope as a physical instrument, and of the correspondingly great progress in the construction of the optical part due to such knowledge, that has been made within the last ten years. Nevertheless, the subject is of great importance to every observer, and although to make it clearly understood it should be treated mathematically, in a manner which the author of this paper would not undertake, it has seemed desirable to present the salient features of our knowledge of the microscope as a physical instrument, in a manner to indicate fairly well the bearing of recent researches upon the scientific use of the instrument. To do this, for the benefit of the biologist, histologist, and others whose time and interests have been too much occupied with their work to study the merits of different objectives and accessories, makes it advisable that we should

\* Read before Section G, A. A. A. S.

begin with some explanations with which many here present are familiar.

Probably every observer of experience has a more or less clear recollection of the long and bitterly fought battle raged among microscopists not many years ago about angular aperture. There were advocates of wide or high angles, who believed the value of an objective increased for all purposes as the angular aperture was increased, independently of other considerations, and this view was advocated with all the steadfastness and vigor of such faith as would move mountains, had it been properly directed to that end. On the other hand, there was a more conservative but none the less vigorous party totally opposed to these views. The bitterness with which this controversy was carried on at times, year after year, is a blot upon the literature of the subject. But the differences of opinion arose, partly no doubt from stubbornness and erroneous observation, but mainly from want of knowledge concerning the subject. There was no recognition of a standard by which the value of an objective could be determined. It was a controversy, in fact, between those who believed in tests by resolving fine markings on diatoms, etc., and those who believed in clear definition of such objects as the podura scale. To be sure, other elements entered into the controversy, as, for instance, the question of the proper measurement of the angle of aperture, but the great question of interest to workers with the microscope was, what is the best objective for use—a wide or medium angle?

At the present time this question can be answered; but a few years ago it was purely a matter of opinion. The theory of the microscope then generally accepted was erroneous. The functions of angular aperture were in theory entirely misunderstood.

Let us endeavor to understand the subject in the light of recent investigations, for which we are mainly indebted to Prof. Dr. E. Abbe, of Jena,

who has established a theory of the microscope, based upon experimental and mathematical investigations, which, in its essential features, if not throughout, seems as firmly established as any theory in optical science.

When an object marked with fine striæ, such as a diatom-shell, for example, or a glass plate ruled with lines and having the markings separated by spaces as minute as the wavelength of light, is illuminated in the ordinary way under the microscope, it is obvious that the light will be decomposed and a diffraction spectrum formed, precisely as in the case of Prof. Rowland's beautiful ruled plates. Considering any single ray from the mirror, when it reaches such an object it will be turned from its direct course and pass off at an angle, forming a microscopic diffraction spectrum. This spectrum may be seen and examined in a manner to be described further on. First I must ask you to recall some old experiments given in text-books on physics. I refer to the interference bands of diffraction spectra. You will remember how the waves of light, when their vibrations come together in a certain manner, interfere with each other and produce lines of darkness due to overlapping spectra. I cannot go further into this subject here. The principle has been brought before you, and that is sufficient for the purpose in view. It must be clear to any one that if the light is thus turned from its course and decomposed, it cannot go on to form an image in the microscope as it was supposed to do according to the old theory of the microscope. It was then supposed that the microscope formed an image precisely as figured in works on physics in use at the present day, and in the same manner as the telescope. Large objects, and outlines of objects generally, are imaged in this way; but obviously this cannot be true of the fine markings closer than a wave-length of light.

Let us see what becomes of the diffracted rays forming the spectrum.



Place a dry-mounted specimen of *Pleurosigma Formosum* under a microscope and examine it with a half-inch objective. When the markings are distinctly seen, remove the ocular and look down the tube of the microscope. There will be seen the diffraction spectra, just above the objective. Then put on the ocular and with a hand-lens examine the light which issues from it in the same way. There the same spectra will be found again. I will not attempt to explain how it is that these spectra are so combined in the image we see to produce the appearance of lines or dots as the case may be. The subject is too intricate to be easily understood; but the fact must be taken upon the authority of Prof. Abbe and others that the power of a microscope to define or resolve minute markings is absolutely dependent upon its capability of gathering in, and properly disposing of, the spectra produced by the object.

We will now go a step further in the consideration of the formation of the spectra. You are all familiar with the fact that diffraction spectra are of different orders—that is to say, we have several secondary spectra produced, one beyond the other, more or less overlapping each other. So it is under the microscope, and the number of secondary spectra will depend upon the fineness of the markings of the object and the length of the vibrations of the light (which will vary in different mounting media). It scarcely need be said that when the object is so finely marked as to produce two spectra the microscope must take in both of these to reveal its finest lines, and if the object produces three spectra that are essential to show its structure, the microscope must take the third in also. Since the rays forming the second and third spectra are diffracted respectively further from their courses than the others, it is obvious that the capability of an objective to take them in depends upon its angular aperture—the angle of light

which it will take in under the conditions of experiment.

We now come to an interesting and exceedingly important fact concerning the appearances produced by diffraction spectra. If an objective is incapable of taking in the spectra necessary for a true portrayal of the object, it may, nevertheless, be made to give an image which, to all appearances, is true, and would not give any evidences of further details to be brought out by other lenses. It may also happen that by proper manipulation an objective capable of showing the finest markings of an object may be made to show the object clearly defined with only one-half the true number of markings—the structure appearing to be much coarser than it really is.

It may be asked how it is possible, in view of such facts as these, to place great dependence upon the microscopical appearance of objects—how are we to be sure that the resolutions we see of fine markings are true, how do we ever know that the objectives we use are capable of showing true structures, or that our manipulation of them has given us the true and not the false?

It is not my purpose to enter upon a discussion of these questions. It would require too much time and involve a more full discussion of the theory of the microscope. Sufficient has been said to place the observer on his guard against errors of this kind. In some cases structure cannot be known from microscopical examination.

We now come to the consideration of angular aperture. The cone of rays radiating from the focal point of the objective to the periphery of the front lens is the angular aperture—the angle of light it will receive. Suppose an object to produce a diffraction spectrum just beyond the range of a certain objective working in air. Interpose a refractive medium like glycerin or water between the object and the front lens. The rays which before were beyond the range of the

objective are now brought, by refraction, to a smaller angular deviation, the spectrum is taken up by the objective and the markings are resolved. We can thus understand the action and the advantages of immersion objectives. It has long been an axiom with microscopists that resolution of fine lines is dependent upon angular aperture; but in this case the immersion medium has materially lessened the angular aperture, yet the resolving power of the lens is increased. Nevertheless, the angular aperture has been shown, under the conditions previously mentioned, to determine the resolving power. The apparent discrepancy here is easily explained, although it has caused interminable confusion in the past. The explanation in brief is this: Angular apertures can only be compared under the same conditions. Thus angular apertures of objectives working dry, or of objectives working in the same immersion fluid, can be compared among themselves, but those of one class cannot be compared with those of the other class. Thus, a dry objective of  $157^\circ$  will resolve no more than one having an immersion angle in water of  $94^\circ$ , or in oil of  $80^\circ$ .

It will be seen that such comparisons are apt to be very confusing, and for this reason the term angular aperture might better be entirely discarded. A perfectly satisfactory method of designating the resolving power of an objective has been adopted by microscopists on the recommendation of Prof. Abbe. It is by determining the 'numerical aperture.' In highly refractive media the undulations of light become much shorter than in air, and as the capabilities of the microscope are dependent upon the wave-lengths, it is obvious that dense media for mounting add to the resolving power. Moreover, the visibility of an object is affected by the relation between the refractive indices of the object and the mounting medium. The more these differ the more visible the object will be. But time would not permit, even

if it were desirable, a longer discussion of the optical action of mounting media of different refractive powers. Suffice it to say that Prof. Abbe has shown, both by experiment and calculation, that the true aperture, distinguished when desirable as the numerical aperture of a microscope objective, which is the capacity of the objective to receive rays from an object to form an image, is the ratio between the focal length and the diameter of the back lens of an objective. This ratio will depend upon the refractive index of the medium or immersion, and is expressed by the product of the index of refraction multiplied by the line of half the angle of aperture for the particular immersion medium employed. This is expressed by the much-used formula  $n \sin. u$ .

Since the resolving power of a microscope depends upon its numerical aperture, and upon the wave-length of light, it must be clear to any person that when the markings of an object are so exceedingly minute that they can no longer produce the diffraction spectra necessary to form a correct image, they are beyond the range of microscopic vision. It will also be understood that since it is a matter involving the wave-length of light, the use of optically dense media to reduce the amplitude of the vibrations of light adds to the resolving power of the microscope. Likewise, finer details can be made out with blue rays than with red, and structures finer than the eye can see may be photographed.

The limit of resolving power has been calculated for different media and apertures, ranging from 1.52, which is theoretically the highest attainable with an immersion medium of refraction index 1.52, since it corresponds to  $180^\circ$  of angular aperture in that medium, down to 0.50, and a table giving the figures is regularly published in the *AM. MONTHLY MICR. JOURNAL*. The range of resolving power at present attained in practice



scarcely exceeds 112,000 lines to the inch,\* which should theoretically be attained with an aperture of 1.16 but the optical construction does not permit of the attainment of theoretical perfection. The highest numerical aperture to be obtained from the opticians is about 1.43.

Before entering upon another and perhaps more generally interesting part of the subject before us, I would wish to draw your attention to a fact that cannot be too strongly brought forward. From what has been said concerning the formation of images of minute markings by the decomposition of the light and the production of spectra, it will be readily inferred that whatever objects will form identical spectral images, no matter how different the structure of the objects themselves may be, their appearance in the microscope will be the same. As a single example to illustrate the practical bearing of this fact, we may consider the resolution of any finely-marked diatom. By changing the illumination the dots may become lines, or the lines in some cases may be made to appear twice as close or half as close as they really are. Time does not permit me to enlarge upon this subject as I would wish, but it has an important bearing upon our interpretation of the revelations of the microscope.

We have already seen that there is a theoretical as well as practical limit to the power of a microscope to separate fine lines. This limit is determined first by the numerical aperture of the objective, and, secondly, by the magnifying power of objective and ocular combined, which in every case must be sufficient to separate the lines in the image until they subtend an angle large enough to enable the eye to distinguish them. This amplification attained, supposing the resolving power of the objective to be tested to its highest limit, no further amplifica-

tion can possibly reveal any finer details in the image. Nevertheless, a slight increase is desirable to render the details more distinct, as all who work with delicate test-objects well know. There is, therefore, a well-defined relation between numerical aperture and amplification which renders it possible to define the limits of adequate and desirable amplification for every objective. A recognition of this fact will show that the use of oculars of excessively short focal length, or high power, must be extremely limited in scientific investigation.

Passing now from the microscope itself, what has been said will enable us to appreciate the value of certain accessories for illuminating objects under investigation. It was not many years ago that the most valued, and likewise the most costly, apparatus for illuminating objects for high-powers was the achromatic condenser, made very much like an objective, with a small front lens, and a complicated system of diaphragms beneath. Fortunately such costly appliances are no longer necessary, and although achromatic condensers are still made their form is quite different from those in general use ten years ago.

For the scientific student there is no device more generally useful than the Abbe illuminator, with its full complement of diaphragms. It is not strictly achromatic, but that is of no consequence. It is not costly compared with other forms, and is well adapted for universal use. It gives the observer complete control over the light, and is a great aid in all delicate observation. I feel like dwelling longer upon this subject to urge the use of this apparatus upon our scientific students. I am aware how many of them affect to despise all accessories. It is because they do not know their value. It will not do to say such things are of no use merely because they have not felt the need of them, for such persons do not know of what they speak. The true stu-

\*120,000 has been claimed, but we are not satisfied with the evidence in support of this, rather improbable, accomplishment.

dent of science should be quick to take advantage of every aid afforded by the optician's skill; as to the practical value of the Abbe condenser there can be but one opinion.

Reasoning from what has been said concerning the theory of the microscope, it will be obvious that a careful management of the illumination is essential to the best results in microscopical work. The mirror alone can be made to do almost everything, but it must be handled with far more skill than most scientific observers possess. They do not acquire such skill in the work that occupies their attention, and for that reason they fail to use the microscope to the best advantage. Not only is this true, but their experience as observers is often too much restricted, and I have known persons of undoubted ability in certain lines of work to make surprising blunders, due to misinterpretations of images in the microscope, which no person of broader experience would make. It is a great advantage to any observer to be able to resolve fine test-objects, as such work gives not only command over the instrument, but it teaches one how to get the clearest definition, and how to avoid or detect false appearances. The use of the Abbe illuminator greatly facilitates the management of the light, and often brings out details of structure very clearly that would otherwise be very easily passed without notice.

The use of polarized light in connection with the microscope is of great importance to the mineralogist, who is enabled to study the optical properties of minerals as they occur in rocks in microscopic quantities. The ordinary arrangements for polarized light serve well enough for such purposes and for the ordinary requirements of the microscopist. A far more elaborate and delicate apparatus for studying the optical properties of minute objects is the polari-spectro-microscope of Rollet\*, or the spectro-

polarizer of Zeiss\* which serves the same purpose and can be attached to the ordinary microscope. Both these instruments consist of a polarizing prism, a dispersing prism to form a spectrum of the polarized light, and a plate of selenite. The different colors of the spectrum can be made to traverse the field of view in succession. The selenite produces dark bands of interference, the position of which depend upon the thickness of the selenite. An object possessing the slightest property of double refraction, such as a piece of muscle, for example, when placed in one of the dark bands adds to the thickness of the selenite, and, in certain azimuths, becomes luminous in the dark band. These instruments are, undoubtedly, the most delicate means we have of studying the optical properties of minute objects, and their value is enhanced by the ease with which the wave-lengths of the light used can be measured.

The relation between resolution of fine lines and the wave-length of light makes it obvious that with blue light finer details can be seen than with light of lower refrangibility; also, as already said, that finer details may be photographed than can be seen. The usual method of obtaining monochromatic light is by the use of a colored glass or liquid interposed in the path of the rays. A more elaborate device has been constructed by Mr. Zeiss. In this, two prisms are mounted as for a spectroscope in such a manner as to throw a spectrum upon the object under the microscope, which may then be examined in light of any color.

### Method of Demonstrating the presence of the Tubercle Bacillus in Sputum.

BY THEOBALD SMITH, M. D., A. M.

In the examination of sputum for the *Bacillus tuberculosis*, it is essential that the sputum be from the proper source, that the method of

\* Am. Monthly Micr. Journ., iv, 168.

\* Loc. Cit., iv, 174.



staining be carefully applied, and that the microscope employed be of sufficient power to bring the bacillus distinctly into view. Among the many methods and modifications of methods that have been suggested, or are in actual use, I select the one now employed by the discoverer of the bacillus himself. It is his original method, considerably modified by Ehrlich and Weigert. In the second volume of the 'Mittheilungen aus dem Kaiserlichen Gesundheitsamt,' Berlin, 1884, he gives a very clear and minute account of it, of which the following is a brief summary:—

Five c.c. of pure anilin (an oily, colorless liquid, later turning brown) is shaken up repeatedly with 100 c.c. of distilled water. In half an hour about three to four per cent. of the anilin is dissolved; the rest of the oil settles to the bottom. This mixture is filtered through a moistened filter, and the filtrate, if not absolutely clear, must be filtered again. The solution, or so-called anilin water, thus obtained does not keep, but must be prepared anew whenever it is to be used.

To 100–150 c.c. of absolute alcohol,\* in a well stoppered bottle, about 20 grammes of dry methyl-violet is added and the whole allowed to stand for several days. Repeated shaking, in the meantime, will aid the solution, which ought to be a saturated one. At the end of this time some of the methyl-violet should, therefore, remain undissolved in the bottom of the bottle, which may be utilized later on by the further addition of alcohol. Fuchsin, when used in place of methyl-violet, is treated in the same way. It is said to be better adapted for permanent preparations.

Eleven c.c. of the alcoholic solution of methyl-violet is now mixed with 100 c.c. of the anilin water, and the staining fluid is ready for use. Koch advises the further addition of 10 c.c. of absolute alcohol, which will pre-

serve the fluid for about ten days without necessitating filtering each time it is used.

The sputum should be as free as possible from intermixture with the secretions of the pharynx, mouth, etc. The expectoration should not be a forced one, the irritation producing the cough being spontaneous and natural. In the foamy mucus will be found small, tough, yellowish lumps, sometimes few in number and sometimes making up the entire bulk of the expectorated mass. A small portion of such a yellow mass only should be chosen. Drawing it to the edge of the glass and up the sides, it may there be broken up into still finer proportions with a scalpel, and spread out in a very thin layer upon a chemically clean cover-glass (after soaking in nitric acid and washing in alcohol) and allowed to dry completely. Some suggest that two cover-glasses be rubbed together with the sputum between them, which will then become very thinly and evenly distributed upon both cover-glasses.

When dry, the cover-glass is drawn through the flame of a Bunsen burner (or alcohol lamp) three times with moderate rapidity, the side covered with the sputum being held upwards, so that the flame cannot touch it directly. Or it may be placed in a dry chamber at 110° C. for twenty minutes. This procedure causes firm adhesion of the layer to the cover-glass even while undergoing the manipulations to be shortly described.

*Staining.*—The preparation is stained by gently placing the cover-glass, with the dried layer directed downwards, upon the surface of the staining fluid in a watch-glass, where it will remain floating. At the end of several hours it is removed. The process may be hastened by heating the staining fluid with the floating cover-glass over a lamp until bubbles appear. It is then removed, and after waiting ten minutes longer the staining is completed. The former method is preferable.

\*95 per cent. alcohol will probably suffice whenever absolute alcohol is spoken of.

*Decolorizing.*—The cover-glass, dark-blue on its removal from the coloring fluid, is transferred directly to a mixture of one part nitric acid and three to four parts water, floated about for a few seconds (at the longest thirty seconds) and then transferred for a few minutes to 60 per cent. alcohol, to remove the adherent acid. The preparation need not now appear colorless. Koch emphasizes this point, and believes that the many failures made in the application of the method are very likely due to the prolonged stay in the acid, whereby the color is finally abstracted from the bacilli themselves.

*After-coloration.*—From the sixty per cent. alcohol the cover-glass is floated upon a dilute watery solution of the complementary stain, vesuvin, if methyl-violet has been used for the primary stain; if fuchsin, methylene-blue. The solution can be prepared from a saturated alcoholic solution kept on hand whenever needed, and should be barely translucent at a depth of 2 cm. After a few minutes it is returned to sixty per cent. alcohol to wash away any adherent staining fluid.

The specimen is now prepared for examination by inverting the cover-glass over a drop of distilled water placed upon a microscopic slide. In general, the after-staining may be dispensed with, as its sole object is to give the various organized substances, including foreign bacteria, epithelial cells, etc., a color which will contrast with the tubercle bacillus and bring it into better relief. If the after-stain be omitted, the specimen is ready for examination after the nitric acid has been washed away in sixty per cent. alcohol.

Koch regards as indispensable in searching for the bacilli a one-twelfth inch water-immersion objective, especially that made by Zeiss, Jena, giving with proper eye-pieces an enlargement of 500-700 diameters, and Abbe's substage illuminator, by which the light is not only greatly increased

in quantity, but the structural details of the histological elements are made to vanish and a pure color picture is obtained. The bacilli amongst masses of detritus, invisible in many cases with ordinary means of illumination, will thus stand out clearly. Oil immersions are still better, but not so necessary as in the examination of sections of tubercle. The organisms brought to view appear as blue rods, if methyl-violet has been used for the preliminary stain; if fuchsin, red, very slender, slightly curved or angled, hardly ever straight, from one-fourth to one-half the diameter of a red blood corpuscle (.0015-.0035 mm.) in length. The field itself will have the color of the second stain, if that has been employed; otherwise it will be more or less colorless, the nitric acid having left the primary stain in the tubercle bacilli only. A systematic search of the whole cover-glass area is to be made by a proper manipulation of the slide-holder and record kept of the number of bacilli present in a certain number of fields, to serve as a means of comparing with other preparations and of roughly determining the relative number present each day, if a series of examinations is being made.

If the specimen has been found a desirable one, it may be mounted permanently by removing the cover-glass\* and allowing it to dry thoroughly, sheltered from the dust. It is then mounted in Canada balsam dissolved in turpentine, without heating. Other solvents of balsam are not recommended by Koch, although xylol has been highly spoken of by some. It is well to re-examine occasionally such permanent mounts, as the bacilli do not always retain the stain; some fade in a few days, others

\* This may adhere to the slide if the water has partially evaporated, and unless care be taken the cover-glass will be broken. If a few drops of distilled water be placed along the edge of the cover, it will be drawn under gradually and elevate the cover: a slight push of the latter towards the water will hasten the process. The cover may then be easily drawn to the edge of the slide and removed, with the aid of more water if necessary. This should be allowed to accumulate along the edge of the cover and drawn off with filter paper,



have kept their color for a year and longer.

Many modifications of the foregoing method have been proposed not only for the primary stain, but also for the agent used in decolorizing. Some methods do away with the latter process entirely in using a double stain at the outset. Many agents have been suggested to take the place of the nitric acid, which I need not mention here. A search through the index of any medical journal for the past year or two will display them all. A thorough understanding and accurate application of this method ought to precede any attempt at modification. In the latter case the examination ought to be confirmed by an application of the original method to the same specimen of sputum until the modification has been found entirely trustworthy. —*Medical Annals.*

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## EDITORIAL.

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**Publisher's Notices.**—All communications, remittances, exchanges, etc., should be addressed to the Editor, P. O. Box 630, Washington, D. C.

Remittances should be made by postal notes, money orders, or by money sent in registered letters. Drafts should be made payable in Washington, New York, Boston, or Philadelphia.

Subscription price before April 1st, \$1 per year, in advance. All subscriptions after this month begin with the January number. After April 1st the subscription-price will be \$1.50.

The regular receipt of the JOURNAL will be an acknowledgment of payment.

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**THE ELECTRIC LIGHT FOR THE MICROSCOPE.**—In a short time we hope to present illustrations of some microscopes with the electric light attachments, which will afford a good idea of what has been done in Germany in perfecting arrangements for its successful use.

The electric light applied to the microscope which was shown by Mr. Walmsley at the Philadelphia meeting served to indicate the great convenience of electric illumination for the purpose. The lamps attached to the microscope were too small for the purpose, but it will require considerable experimenting to determine the most useful size. For low powers it was quite satisfactory, and no

doubt would be entirely so with a portable and lasting battery. This, unfortunately, Mr. Walmsley did not present, probably for the very good reason that no such battery can be obtained.

We have since heard something of a battery that has been especially designed for this purpose, which is easily renewed and not very high in first cost. It measures 11 by  $3\frac{1}{4}$  inches, by  $5\frac{1}{2}$  inches in height, and will run a lamp of  $2\frac{1}{2}$  candle-power steadily for a considerable time. The details are not yet available, but in a short time we hope to give a full account of experiments to test the efficiency of the apparatus.

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## NOTES.

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—Another stain that the histologist, and especially the student of micro-botany, frequently has occasion to use is the so-called indigo-carmin, or sulph-indigotate of potash solution. Like the foregoing (picro-carmin) the text-books content themselves with recommending it, but give no working formula for preparing it. The following process gives a brilliant, beautiful blue that works well with almost any kind of preparation, and is most useful in the double staining of vegetable sections. Take of the best indigo, in lump, 30 grains. Powder in a capsule, and dry thoroughly in a water bath. When perfectly dry, add 2 drachms (by weight) of fuming (Nordhausen) sulphuric acid, adding it drop by drop and stirring with a glass rod. As the indigo swells under this treatment, a large capsule is necessary. The whole of the acid having been added, stir well, cover, and let stand for twenty-four hours. Transfer to a tall flask, and add 3 ounces of distilled water. Let stand for four days, giving the flask an occasional shake. A magnificent blue color is now attained, but its acidity prevents its being used in this condition. The solution must now be neutralized by the addition of carbonate of potash (or soda) added cautiously, with frequent testings, as an excess of the alkali causes the separation of the indigo in a doughy mass (which can be redissolved, however). Filter the neutralized solution, and evaporate to dryness. For use, dissolve in 50 times its weight of distilled water.—*National Druggist.*

—Messrs. H. R. Spencer & Co. have recently patented a device to protect the interior and backs of objectives from dust. It would have been described before but for the absence of the Editor from Washington, where he expected to receive an objective with the protector ere this. It consists of a thin piece of plate-glass polished, and mounted in a ring screwed into the back of the objective. It is said to be a valuable addition to a lens, as no doubt it is, while not affecting the corrections or interfering with the performance of the objective in any way. The plan will especially commend itself to all workers who leave their objectives attached to the stands, as dust is sure to find its way to them, even under glass shades.

—Mr. J. C. Lathrop, who has an abundance of the wonderful *Bacillaria paradoxa* available for study, desires to know how to isolate the peculiar diatom for mounting. He also wishes to know whether it is common or not. As regards the mounting, no doubt our readers can give him the desired information. As to its abundance, we can only say that about New-York it is not regarded as an unusual form in gatherings from salt or brackish water. It would be of interest to know how widely it is distributed in this country, and we ask our readers\* to give this information.

—At the National Museum Mr. Harry English has been engaged for some time in preparing and mounting a typical series of vegetable fibres. Most of the mounting is done in a mixture of glycerin and water, which is thought to be the best medium for the purpose. The collection of mounted specimens will be exceedingly useful when it is completed, as it is intended that every species of vegetable fibre in the Museum cases shall be mounted for examination at any time, thus obviating the delay of preparation.

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## CORRESPONDENCE.

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### Objectives—Pond Life.

TO THE EDITOR:—During the two years during which I have read your JOURNAL I have looked for some expression from you regarding the value of homogeneous immersion lenses. From articles I am convinced that they have a value, but whether commensurate with their cost I do not feel satisfied. A brief statement will show my position. For years I have been a student of gross anatomy and systematic

biology. Two years ago I took up the microscope and began histological work. I have a good stand, but no powers above a dry working  $\frac{1}{4}$ . I have come to a point where this will not do all that I want. Having no opportunity to make personal observations and comparisons, I am in doubt where it is best to purchase. A Hartnack water immersion giving about the power I want costs \$45, a Spencer homogeneous  $\frac{1}{10}$  about \$55, and so on. Are the immersion lenses worth the price? I cannot expect a busy professional man to have time for a personal answer. If you can give me a hint through the JOURNAL, it will help me much.

The application I have made of some hints in the JOURNAL may be of interest. A few months ago a correspondent suggested in the columns of the JOURNAL the placing of slides back to back, and then suspending them from hoops in ponds. I modify his plan by taking waxed paper (from cakes of soap) and punching holes slightly smaller than my largest covers, then wrapping the paper about the slides in such a way as to bring the holes in the middle on each side; then suspending the slides, I secured growths on a space a little smaller than my covers, and am able to secure good mounts many times. I am now making a new application which pleases me much. Taking a slide with a spot of growing forms upon it, I surround it with a cleft ring, as in Hardy's vivarium, bind on another slip, as suggested, and the little world is ready for observation.

[We will endeavor to answer our correspondent's inquiry next month. Some light will be thrown upon the question by the article published in this number, on 'The Microscope as a Physical Instrument.'—ED.]

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## Exchanges.

[Exchanges are inserted in this column without charge. They will be strictly limited to mounted objects, and material for mounting.]

Echinus spines of various species offered to any person who will send in return three good sections of the same.

Box 630, Washington, D. C.

Wanted—Diatoms on seaweeds and in muds, from all the tropic seas. Offered a large quantity of fine selected diatoms and other slides, or cash.

J. C. RINNBOCK,  
14 Simmering, Wien, Austria.

Will exchange well mounted slides for others well mounted.

H. H. PEASE,  
1271 Broadway, N. Y.



# THE AMERICAN

## MONTHLY

# MICROSCOPICAL JOURNAL.

VOL. V.

WASHINGTON, D. C., NOVEMBER, 1884.

No. 11.

### The Microscopic Investigation of the Brain and Spinal Cord.

BY W. T. COUNCILMAN, M. D., ASSOCIATE IN PATHOLOGY, JOHNS HOPKINS UNIVERSITY.

The means which have been generally used up to the last year or two for the microscopic investigation of the central nervous system have been very imperfect. Carmine has been generally used as a staining reagent, and it stains most of the nerve fibres very well. It is also unequalled for staining the large ganglion cells in the grey matter, but the fine nerve fibres in this are not brought out, for they are embedded in a substance which stains just as do the axis cylinders. The same holds good also for hæmatoxylin and the most of the anilin colors. Other methods, as the gold chloride staining, and that recommended by Exner of osmic acid, after previous treatment with ammonia, give much better results; but the necessary manipulations require great care, and the results are very uncertain. The gold method can only be used on perfectly fresh material, and hence is practically out of the question in human tissues; preparations by both this and osmic acid have the further disadvantage of changing in a short time.

For any investigation of the nervous system, whatever be the method used, it is necessary to obtain the specimens at a much earlier period after death than autopsies are usually made. No tissue in the body suffers so much from post-mortem change as the nervous tissues, and although, in some cases, tolerable results may be

obtained when twelve or fourteen hours have elapsed between the death and the autopsy, it is in all cases better to obtain the material after only four or six hours have elapsed.

The cord should be taken from the body entire, still enclosed in the dura mater, and all pulling and hauling on the cord be avoided. The dura can be grasped with a pair of forceps, and the small amount of traction necessary in raising the cord to cut the spinal nerves be made upon this. After the cord is removed the dura must be slit up anteriorly, and with a sharp knife incisions must be made through the cord at intervals of one inch. The whole cord should then be suspended in Müller's fluid in a tall vessel. The pieces of brain to be examined should not be more than 1 to 1½ inches square, should be cut with a sharp knife, and handled as little as possible. The medulla and pons may be left entire. The pieces of brain or medulla should be laid on absorbent cotton in a vessel previously filled with Müller's fluid. Under ordinary circumstances it takes for such tissues to acquire the proper degree of consistency more than two months, but the process of hardening can be shortened in various ways. We can either add to the Müller's fluid a small quantity of copper sulphate, or substitute for it the fluid of Erlicke:—

Potassic bichromate .....	2.5
Copper sulphate .....	.5
Distilled water .....	100.0

The addition of the copper gives a slight greenish tint to the tissues, but does not interfere with the staining. In this fluid tissues become sufficiently

hard in seven or eight days. Much better results are obtained when Müller's fluid alone is used, and is kept while the hardening is going on at a temperature of  $42^{\circ}$ – $45^{\circ}$ C. By this means in five or six days a whole human medulla is hard enough to cut. The fluid should be changed daily.

After becoming sufficiently hard, the tissue may be embedded in celloidine, or simply cut in thick slices, and these gummed on cork. After being gummed on cork they are left for a few hours (5 to 10) in absolute alcohol. If the hardening has been perfect, it is possible to cut with a sharp knife on the sliding microtome sections of  $\frac{1}{50}$  of millimetre without any process of embedding. After the sections have been cut they are placed in water which contains 1 or 2 per cent. of alcohol. This small addition of alcohol is necessary to prevent the sections from breaking up. From the water the sections are placed in a dish filled with saturated aqueous solution of acid fuchsin. This is altogether different from the ordinary fuchsin which is used in staining tubercle bacilli, and its staining substance is an acid instead of a base, as in the common fuchsin. The sections remain in the staining solution for ten to twenty hours at ordinary temperatures, or for two hours at a temperature of  $40^{\circ}$ – $45^{\circ}$ C. After being slightly washed in water they are placed in a solution of caustic potash in absolute alcohol, 1–1000. This is best made by keeping on hand a standard one per cent. solution, and diluting this ten times before using. The sections remain in this solution until a differentiation of the tissue is seen, the white matter remaining an intense red and the grey gradually becoming paler. The whole success of the staining depends on the washing out, and the sections must be carefully watched until the proper degree of differentiation is seen. Then the sections are placed in distilled water and after remaining in this a

few minutes put through alcohol and mounted in balsam.

Xylol will be found to answer better to extract the alcohol than any other agent. The nerve fibres, both in the white and grey matter, will be stained a brilliant red and the nerve cells and nuclei a bluish red. If it be desired to make the staining of the nerve cells more prominent, the sections may be afterwards stained in hæmatoxylin. This method was discovered by Weigert (*Central-Blatt F. D. Med. Wissensch.*, 1882, p. 751), and he has lately (*Fortschritt D. Med.*, Mai, 1884) published another method which is not only more simple, but gives results which are in the main better. It is proper to say here that Prof. Weigert has done, perhaps, as much as any man living to give us methods of working which have been of incalculable benefit, not only in pure histology, but in pathology.

After the tissues have been hardened in Müller's fluid in the manner just described the sections are placed in water, and from this into the following solution of hæmatoxylin:—

Hæmatoxylin.....	0.75
Absolute alcohol.....	10.00
Boiling distilled water.....	100.00

They should remain in this (filtered) solution at a temperature of  $45^{\circ}$  C. for one hour; they will then be an intense, dark-blue color, and uniformly stained. No differentiation of the grey matter from the white can be observed. From the hæmatoxylin solution they come into the following:—

Borax.....	2.0
Potassium ferricyanide.....	5.0
Water.....	100.0

This has the same effect in bringing about a differentiation that the potash solution had on the fuchsin preparations, the white matter remaining blue and the grey becoming paler. The secret of successful staining in both methods lies in the decolorization. A little experience will,



however, soon tell one when the desired point is reached. From the cyanide solution the sections are washed out in water and mounted in balsam in the ordinary manner. The nerve fibres in both the white and grey matter will have a dark purple color, the nerve cells a bronze tint, and the connective tissue a brilliant saffron tone.

Any one using these methods for the first time will be struck with the richness of the net-work of nerve fibres in the grey matter of the cord. What was formerly spoken of as gelatinous substance or neuroglia will be found to be mostly nerve fibres. As said, they are not visible under ordinary circumstances, because the intermediate substance stains as intensely as the axis cylinders. At first sight it will appear that the axis cylinders are stained, but closer inspection with high powers will show that these are really unstained, and the white substance of Schwann has taken on the color. In the middle of the bright red or purple spots which represent the cross sections of nerve fibres the unstained axis cylinder can be seen. It is in all respects just the opposite to the ordinary staining of carmine and hæmatoxylin.

These methods are invaluable in the pathology of the cord in tracing degenerated nerve tracts. The degenerated fibres are unstained in the fuchsin and stained yellow with the hæmatoxylin, and they offer a striking contrast to the other parts of the cord. However, for staining the cord or brain to show lesions other than those of the nerve fibres, I have found the best results can be obtained with picro-carmine. This can either be made in the manner recommended by Weigert (*Virch. Arch.* B'd. 84) or after the formula of Ranvier. It is always a matter of great difficulty to procure a picro-carmine which stains well, and its making seems to depend quite as much on chance as skill. It should always be kept a long time after being made before it is used. I

have frequently found that an old forgotten solution covered with mould would stain in the most brilliant manner, while a fresh solution carefully made would give but imperfect results. The sections should remain in the carmine 24 hours, and then be washed out in water which contains a slight percentage of picric acid. Whatever be the method used, it is essential to have fresh tissue to begin with.

—o—

### New Microscope Lamps.

Through the courtesy of Messrs. Walmsley & Co. we are enabled to present this month an illustration of Messrs. Beck's new 'complete' lamp, for use with the microscope. There are now in the market a lamp known as the Nelson-Mayall, an improvement on the original form of the Nelson lamp, which may be regarded as the predecessor of the later ones; the Beck lamp, and one which has not previously been described, devised by Mr. Bulloch.

The value of these lamps will not be immediately appreciated, except by those who have had experience in the refinements of manipulation with the microscope. For fine work and delicate management of the light, either for purposes of observation or display, they are very useful. Although not indispensable to the working microscopist, they are certainly a great convenience, and those who can afford to purchase the best apparatus should not neglect to add a good lamp to their collection. It is true, one can do anything with a common hand-lamp and a good bull's-eye condenser that can be done with these lamps, but at no little sacrifice of time and patience. Those who are accustomed to regarding a student's or an ordinary hand-lamp as quite sufficient for all purposes, will be unable to understand the superiority of these more elaborate and expensive devices. We shall endeavor to explain their advantages in a few words.

Too much attention cannot be given to the course of rays which impinge upon the mirror of the microscope. It will be understood that we now allude to work of a delicate nature, in which the capabilities of the microscope are severely tested. All illuminating apparatus is constructed to work most perfectly with parallel rays of light. Consequently, when using any sub-stage apparatus—condenser, paraboloid, or other device—it is desirable that a beam of parallel rays be directed upon the mirror. The rays from a lamp can be made

rious angles by means of a milled head acting against the started pin *K*. By temporarily removing the upper part of the chimney *F* the condenser can be swung over to the other side, and the beam can then be directed downward, below the horizontal, as would be required to illuminate opaque objects. By sliding the condenser along its support, the light may be rendered parallel or convergent, as may be desired.

The chimney and the reservoir containing the oil are independent of each other, and the latter, with the burner, can be revolved, thus presenting the edge or the flat side of the flame at will.

The lamp slides up and down on the square upright *B*; when in its lowest position the flame is only three inches above the table on which it stands.

One fault in this lamp, which

immediately suggests itself, fortunately one easily remedied, is the necessity of removing part of the chimney and turning the condenser over to the other side to obtain a beam directed down-

approximately parallel by properly arranging a bull's-eye lens in front

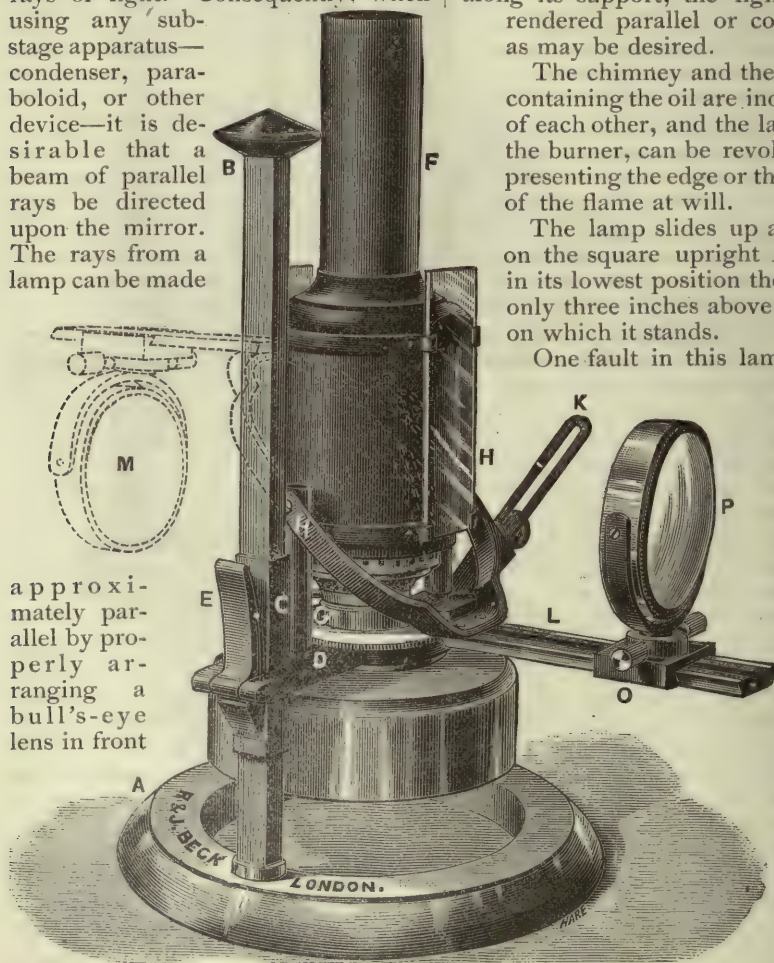


FIG. 26.—Beck's New Complete Lamp.

of it. In the lamp now under consideration the bull's-eye *P* slides upon a bar *L*, in front of the aperture *H* in the metal chimney. The bar *L* swings on pinions at *H*, which enables the bull's-eye to be set at va-

ward. It is especially inconvenient to do this after the lamp has been burning a short time, as the metal chimney becomes very hot. In fact, we may assure every intending purchaser of any of these lamps that



one of the first uses he will make of such a lamp will be to burn his fingers on the chimney—a propensity, however, which he will soon overcome.

Mr. Bulloch's new lamp is shown in Fig. 27, and the first one made was

sent to us for examination last month. Having used it somewhat in practical work, we can speak well of its convenience and efficiency. It will be seen that the reservoir and base are similar to those of the Beck lamp, but that the burner, instead of being on the middle on the reservoir, is placed on one side. This gives room for a brass upright on the other side, which supports the bar carrying the condenser. The latter is focussed by sliding the bar in either direction, and the light is directed either upward or downward by swinging the arm as required, and clamping it in any position by the milled head shown. Only one side of the chimney is open, and the rectangular aperture is covered with a plane glass  $3 \times 1$  slip, outside of which may be slipped in a blue slide or one with a ground surface to modify the light. There is also a brass slit, adjustable in width, which fits outside of all. This is intended to give a narrow line of light. The chimney turns about the burner, so that the broad face of the flame or the edge can be used at pleasure.

The reservoir, carrying everything upon it, moves up and down by a rack and pinion on the upright bar from the base, as clearly shown in the cut.

The lamp presents an attractive appearance, the chimney and reservoir being nickel-plated and the other

parts of brass. It is rather simpler than Beck's.

Not the least of the advantages offered by these lamps is the opaque chimney, which prevents any glare or strain upon the eye, and confines the light strictly to where it is desired.

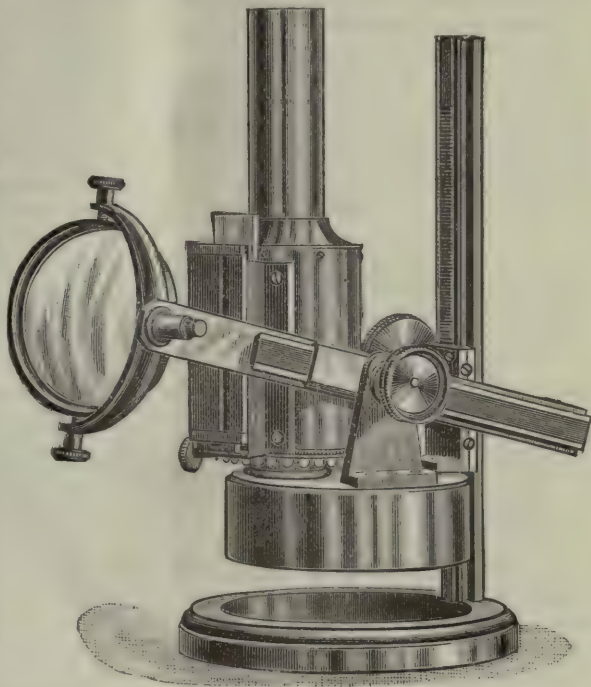


FIG. 27.—Bulloch's New Lamp.

### Magnifying Power.

BY E. GUNDLACH.

There is a general uncertainty as to the magnifying power of an objective and the way it should be determined.

A lens shows an object magnified because it shortens the distance of distinct vision, or rather the focal length of the eye. The general mistake made in determining the magnifying power of a lens is to simply divide the focal length of the eye by the focal length of the magnifier. If this were the correct way, then, for instance, a lens of ten inches focal length would not magnify at all (the

focal length of the eye being taken as ten inches), and a lens of eleven inches, or more, would even reduce the apparent size of the object. But this, we know, is not the case.

A lens shows an object just the size that the unassisted eye would see it if the focal length of the latter were equal to the focal length of the magnifier and the eye. Now, let  $m$  represent the magnifying power of the lens,  $v$  the distance of distinct vision, or focal length of the eye,  $f$  the focal length of the magnifier, and we have the formula :

$$m = \frac{v+f}{f}$$

According to which the magnification of a lens of one-inch focal length, for instance, the focal length of the eye being taken as ten inches, would be eleven diameters, not ten diameters, as is commonly supposed. The magnifying power of a 2-inch lens would be 6 diameters, that of a 10-inch lens would be 2 diameters, and a 20-inch lens  $1\frac{1}{2}$  diameters.

A half-inch eye-piece magnifies the image of the objective 21 times (linear), a one-inch 11 times, and a two-inch 6 times.

A similar mistake is also made in determining the magnifying power of objectives. It is commonly supposed that by simply dividing the tube-length, or rather the distance of the image from the objective, by the equivalent focal length of the latter, that we get the magnifying power of an objective. If this were so, then, for instance, a five-inch objective would, with ten inches tube-length, give a magnified image of two diameters; while, in fact, it does not magnify at all. That is, the image will be just equal in size to that of the object. The size of an image formed by a lens or an objective is to that of the object as the distance between the image and lens to the distance between lens and object. Now, if a true five-inch objective had to be just five inches from the object to form an

image at ten inches distance, then the magnifying power would certainly be two diameters. But, to form an image, the distance of a lens from an object has to be greater than the focal length of the same. To form an image at two focal lengths of the lens it has to be at an equal distance from the object. Therefore, a five-inch objective will, with ten inches tube-length, have to be just ten inches distant from the object to be in focus; and consequently the image formed by it will be equal in size to the object. If  $m$  be the magnifying power,  $t$  the tube-length, and  $f$  the focal length of the objective, then we have this formula :

$$m = \frac{t-f}{f}$$

According to which a one-inch objective, for instance, will, with ten inches tube-length, give an image magnified nine diameters, and not ten, as is commonly supposed. A two-inch will magnify four diameters and not five.

Having now found the correct formulæ for the computation of the magnifying powers of both the objective and the eye-piece, it is a simple matter to properly combine them to a complete and correct formula for the computation of the magnifying power of the compound microscope, which is—

$$m = \left( \frac{t-f^1}{f^1} \right) \frac{v+f^2}{f^2}$$

In which  $m$  is the magnifying power of the compound microscope,  $f^1$  the equivalent focal length of the objective,  $f^2$  the equivalent focal length of the eye-piece,  $t$  the tube-length,  $v$  the distance of distinct vision or focal length of the eye. According to this formula, a combination of a one-inch objective and a one-inch eye-piece will, at ten inches tube-length, give a magnification of 99 diameters, not 100, as is commonly supposed. A four-inch objective combined with a two-inch eye-piece will magnify 9 diameters, not 12.5.



### Griffith's New Turn-Table.

Some time ago Mr. Griffith furnished us with a cut illustrating his new turn-table, but owing to our absence from home it has been overlooked until now. On page 126 will be found an illustration of a simple form which preceded this one. The centering device was somewhat different, as well as the general construction.

In the later form, which is represented in fig. 28, four pegs project from the face, two near the margin, which receive the corner of the slide, and two situated on a central, circular

drawings was often a quite laborious task. The advent of the hektograph was hailed by many as a deliverance from this drudgery, but unfortunately the hektograph has not proved what was expected of it. There is a limit to the number of copies it will give, and it often fails to reproduce well fine details of the original drawing. Still later photography has been popularized, and now we enjoy the ability to furnish any number of faithful copies of a drawing, as well as the more generally employed method of photographing, by means of the microscope, the object itself. Although



FIG. 28.—Griffith's New Turn-Table.

piece which is flush with the surface. This central piece turns freely, and is acted upon by a concealed spring, which causes the two pins to secure the two sides of the slide and press it against the outer marginal pegs. The device is rather difficult to describe clearly, but with the aid of the cut, perhaps, the action will be made clear.

This turn-table may be obtained either in the form shown in the cut, with the iron hand-rest, or with the revolving face on its pivot without the rest, arranged to be screwed down to the work-table.

—o—

### Multiplying Drawings.

In years past, when a naturalist or microscopist came across a new or unfamiliar form, and desired to send sketches or camera drawings to his correspondents, the copying of the

an old process, it has but lately been brought within the reach of all, and is probably the best of all methods; but there are certain drawbacks even to this process. Not every microscopist has an outfit suitable for copying drawings by photography, and most of them confine their work to the production of photographs from the object itself, frequently having no other lenses than those of their microscope.

In such cases it is soon found that camera lucida drawings cannot be wholly replaced by photographs. It is frequently impossible to obtain good photographs of structure that can be clearly seen and drawn; so it often happens that the enthusiastic amateur in microscopical photography is much disappointed and perhaps disgusted at having to go back to camera lucida drawing when he thought he had discarded it for good.

But there is an easy escape from the difficulty by means of the well-known ferro-prussiate process. Let the camera lucida drawing be made with good black ink directly upon tracing-paper placed over white paper, or it may be drawn on white paper and carefully traced on tracing-paper. In either case, when dry, gum the tracing-paper on a sheet of clean glass, with the drawing next the glass; it may then be printed from as an ordinary negative, and any lettering will be reproduced in its proper position.

With suitably-prepared ferro-prussiate paper in clear sunlight it prints quicker than an ordinary gelatine negative; from 10 to 15 seconds will suffice for well-made drawings on clear paper. The copies are thus made very quickly in any number, and are rinsed in water and dried much more quickly than an equal number of silver prints could be toned and fixed. Fine details are well reproduced by this method, which, though an old one, seems to have fallen into disuse, except by engineers and architects, who still use it for reproducing plans, etc.

In a future paper I will give some formulæ for rapid printing paper, and a method by which waste developer may be used for the production of paper suitable for proofs, etc., and some 'wrinkles' in the line of photography as applied to microscopical purposes.

C. M. VORCE.

[The plan proposed by Mr. Vorce is an excellent one, although it does not dispense with the necessity of camera lucida drawings. As this seems to be a desideratum, we add a few words which may be found useful by some readers. Instead of making a camera lucida drawing, take a negative from the object in the usual way and make a blue print on the ferro-prussiate paper. The drawing may then be traced from that on the tracing-paper, which would, doubtless, be a better plan for those who cannot use the camera well;

but the following plan, which we would suggest for trial by some experimenter, is even better. Mr. Vorce promises a formula for the ferro-prussiate paper, so we will not give one at present. Our plan is to coat very thin and transparent paper with the ferro-prussiate solution, and print from the negative upon that. Then draw the outlines and necessary details on the print with India ink. Having done this, bleach out the blue picture with very dilute ammonia, which will leave the paper white, with the black, ink lines intact. Should there be a yellowish color left on the paper, a little weak acid will remove it. After the paper is washed and dried it may be spread on a flat, heated plate—a flat-iron, for example—and paraffin rubbed over it. This will make the paper transparent,—like the 'wax-paper' used by the confectioners to put up caramels, etc.—and it can then be attached to a glass plate, as suggested by Mr. Vorce.—Ed.]

—o—

### The Use of Chinese Ink in Microscopy.\*

BY M. LEO ERRERA.

An object is seen in the microscope more or less clearly as its index of refraction and its color differ from the index of refraction and color of the surrounding medium. Thus, to render more apparent delicate details of structure we place the objects in a very refractive medium, or we cause them to absorb appropriate coloring matters.

Certain objects permit coloring matters to penetrate them with difficulty; others reject them entirely; still others permit the reagent to traverse them readily, but do not retain the color. In such cases we may resort to a process the inverse of that habitually employed—color the surrounding medium instead of the object. Hofmeister recommends this method for

[\* Translated for this JOURNAL from *Bull. Soc. Belge de Micr.*]



the observation of certain gelatinous substances in colored alcohol, and Seiler proposed to show the grains of starch in a glyceric liquid colored with anilin blue.

The coloration of the object, as well as of the medium in the manner ordinarily practiced, is not applicable to living organisms. These refuse, in fact, to absorb the coloring solutions. The exceptions to this rule, which Brandt and Certes have indicated, are only apparent. According to Brandt, the nucleus of living protozoa may be colored pale violet by a dilute solution of hæmatoxylin, and the oily globules of these creatures by Bismarck brown. Certes has observed the latter action with cyanine or quinoleine blue. But in all these experiments the protoplasm, properly so called, remains colorless, and the colored solution always exercises an injurious action upon the vitality of the organisms; it is only tolerated in a condition of great dilution and during a short time.

If, on the contrary, one applies the other method, and places the living things in a liquid, however slightly colored, without endeavoring to color the creatures themselves, death is also likely to be brought on, either by exosmosis, or more frequently by true poisoning.

It may, therefore, be useful to possess a strongly colored liquid which is not poisonous, and which exerts no sensible osmotic action upon the microscopic creatures placed in it. To satisfy these conditions, it suffices to substitute for colored solutions water holding in suspension insoluble colored powders. It is from this point of view that I would call attention to the use of Chinese ink. Its innocuous nature and its intense color makes it very suitable for the use of which I speak. It consists, as is well known, of lamp black and of gummy matter, very slightly aromatized with musk or camphor. By mixing it with water a very black liquid is obtained, due to the fine particles of

carbon which it holds in suspension; but this liquid does not affect living cells, and organisms will live in it perfectly well.

A little China ink of good quality, but not much scented, is mixed with water in a porcelain dish. It is well to triturate it carefully; the liquid should present, under the microscope, excessively small, equal granules, animated by Brownian motion; it should have, in a very thin layer, a tint of a dark gray color, but not of an opaque black. A drop of this liquid is placed on a slide, the objects to be studied are disposed on a cover-glass which is applied upon the drop of the black liquid. In this way the black particles are prevented from getting between the cover and the organisms to be studied. The latter appear remarkably clear on the gray-black ground, so that their details are seen with clearness. The carbonaceous matter does not seem to incommode the microscopic organisms; they conduct themselves very well, and I have preserved the spirogyras, vaucherias, and infusoria living for several days.

For prolonged observation, it is naturally advisable to make use of a moist chamber to prevent evaporation, by placing the preparation in an atmosphere saturated with aqueous vapor. Ordinarily I employ the moist chamber of Strasburger, which is composed of a piece of wet cardboard on a slide, and pierced with a central circular opening upon which the cover-glass is applied. The latter carries the organisms in a drop of water on its lower surface.

Permanent preparations may also be made with China ink. For this purpose one replaces, little by little under the cover-glass, the China ink mixed in water with China ink mixed in glycerin. It is always necessary to so operate that the black liquid does not go beyond the edges of the cover, as it would produce currents by evaporation, and the black particles would not be uniformly distributed.

It is especially to demonstrate the gelatinous sheaths, so common among the lower creatures, and the jellyfied membranes of higher plants, that the China ink appears to me to be serviceable. The gelatinous envelopes of many filamentous algæ, glæocapsas, colonies of zooglæa, etc., are readily distinguished from the water, and it is generally difficult to see them well and to determine their contours; nothing is so easy, on the contrary, when one observes with water charged with China ink.

This method might also be applied with some advantage in the study of the digestion of infusoria, the movement of diatoms, ciliated organisms, etc.

[The method of observation described above we have occasionally applied with perfect satisfaction in the past, and can bear testimony to its value. The use of China ink for studying the digestive processes of infusoria and the movements of cilia has been advised by previous writers. It is better than carmine for the purpose, as the particles seem to be held in suspension better, and they are more uniform in size.—ED.]

—o—

### Microscopical Technic.

#### VIII. CONCLUDING REMARKS ON MOUNTING.

In the articles which have been published this year upon this subject the writer has endeavored to meet the wants of the largest number of readers by giving such information as would be most useful in general microscopical work. Specialists will have their own methods, and it would not be of general interest to extend these articles further for the purpose of detailing special methods. For this reason we have refrained from describing the methods of preparing animal tissues. Whoever engages in such work will find full instructions in the books that will surely be at hand.

Occasionally we receive prepara-

tions which are prepared for display by very ingenious and effective methods. Hereafter when such specimens reach us we shall endeavor to describe the methods of preparation, or induce the preparers to do so, which will be still better. Just now we have in mind a method of mounting the disk-like forms of the foraminifera—such as *Peneroplis*, *Orbiculina*, and *Orbitolites*—which was first used, so far as our recollection goes, by Mr. C. C. Merriman, who has made some beautiful preparations of the kind, and already given in these columns. Other objects, such as the large discoid diatoms, for example, could doubtless be mounted in the same way, with satisfactory results. The method is as follows:—

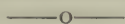
Prepare the shells as for mounting in balsam. Choose a  $\frac{3}{8}$ -inch cover-glass and place it on a slide on the warm brass mounting-table. Place the shells upon the cover-glass, with sufficient balsam to entirely cover them, and continue the heating until the balsam is thoroughly hardened. The shells should then be found lying flat upon and in close contact with the cover-glass, and artistically grouped. The hardened balsam should cover them well. The cover-glass is then placed on a turn-table, face down as before, and a coat of shellac applied as a backing for the balsam. When this is dry a thick backing of Brunswick black or asphalt is applied and allowed to dry. Turning the cover-glass face up, it will be seen that the shells are now mounted in balsam and apparently embedded in a perfectly black background. With a strong light condensed upon them by a bull's-eye lens or a side reflector they are very beautifully shown. It only remains to attach the cover-glass permanently to a slide, which can be readily done by means of a curtaining cell, or in any convenient manner. In any case, the bottom of the cell should be made opaque with asphalt or other varnish.

In the case of opaque objects it fre-



quently happens, with some preparers, that the cover-glass becomes covered with a film of oily or watery particles which condense upon its under surface. This matter has already been alluded to under dry mounting, but Prof. W. A. Rogers, whose rulings, as formerly prepared, were frequently injured in appearance by this condensation, has at last, so he believes, entirely obviated the annoyance. He now uses a brass ring for a cell to hold the ruled cover-glasses, but free communication between the air within and without the cell is established through a minute perforation in the side of the cell. Some preparers have been in the habit of maintaining free communication between the air without and within the cells by leaving a bristle or a thread of some kind passing through the wall of the cell until the mount is finished, after which it is withdrawn, thus making a minute perforation.

The writer, being absent from home and unable to consult memoranda and books of reference, has been unable to give the promised formulas of various mounting media in this article. They will be given in future. There will also follow some instructions for killing and mounting soft and very delicate organisms, such as *amœbæ*, *infusoria*, etc. It requires considerable skill and experience to make preparations of this kind that are of lasting scientific value, but the results that can be obtained are well worthy of the expenditure of time required.



### Microscope of Large Field.\*

Of late years there has been seen in the domain of *technique* in anatomy a reform which to-day is almost complete. For the scalpel and dissecting needle have been substituted the razor and microtome; for the laborious dissection of minute organisms under the mounted lens the more sure

method of successive sections is preferred. Applied first to the study of objects of very minute size, the method of successive sections has become rapidly generalized, and to-day it is applied with success in the researches made on creatures of which the section measures sometimes several centimeters in diameter (adult plants, young fishes, small reptiles, etc.)

From this it has resulted that the dissecting microscope has been little by little discarded and replaced by the ordinary compound microscope. But the latter, owing to its magnifying power, is especially adapted to the detailed histological study of the organs. The small field of view, on the other hand, makes it less useful in the study of the relations of position presented by the various kinds of tissue in a section of large diameter. The need of a new optical instrument begins, therefore, to be felt among naturalists.

Several months ago, finding myself at the house of M. Nachet, in Paris, I spoke to that able constructor of this desideratum of anatomical laboratories. M. Nachet immediately showed me a microscope which he had made for the purpose of observing large sections with a feeble magnification. If this new microscope does not realize all the perfection desired, it still constitutes a very happy tentative device, and a real progress. I believe, therefore, a description of this instrument, which is now in the possession of the laboratory of the Botanical Institute at Liege, will be of value.

The new microscope of Nachet is a compound microscope, which differs from those in use by some modifications which I shall proceed to mention.

The stand is much larger than ordinary. The stage has a large opening illuminated by a mirror of large diameter. The tube, of which the invariable length is 195 mm. and the interior diameter 29 mm., is provided

\*Note by M. A. Gravis. Translated for this JOURNAL from *Bull. Soc. Belge de Micr.*

with a carefully-made toothed rack. The slow movement, being useless for the slight magnification, has been suppressed.

The objective is variable; that is to say, it gives all magnifications comprised between two limits. This result is obtained by the separation, more or less great, which may be given to the lenses of the system by means of a sliding tube. The image formed by this objective is perfectly aplanatic, quite to the borders of the field, but slightly obscure and milky for the fine details. I presume, however, that this defect is not due to the objective, but in part to the ocular and in part also to the excessive length given to the tube.

The ocular, of a diameter superior to the ordinary oculars, is constructed to give a large image of the object. The apparent diameter of the field, measured at the distance of 255 mm., by means of a camera lucida, is 200 mm. With the ordinary ocular No. 1 of Nacht the same diameter is 135 mm.; with ocular No. 1 of Prazmowski it is only 110 mm.

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## EDITORIAL.

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**Publisher's Notices.**—All communications, remittances, exchanges, etc., should be addressed to the Editor, P. O. Box 630, Washington, D. C.

Remittances should be made by postal notes, money orders, or by money sent in registered letters. Drafts should be made payable in Washington, New York, Boston, or Philadelphia.

Subscription-price before April 1st, \$1 per year, in advance. All subscriptions after this month begin with the January number. After April 1st the subscription-price will be \$1.50.

The regular receipt of the JOURNAL will be an acknowledgment of payment.

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**THE JOURNAL NEXT YEAR.**—As there has been one leading feature in the JOURNAL this year, in the articles on Microscopical Technic, so next year it is proposed to publish a series of illustrated articles, describing in a popular way some of the objects which are sure to be found by microscopists in the course of their work. The subjects have not yet been selected, but the plan has been thought out, and

will be more definitely announced either in December or January.

We are obliged to admit that some articles which were mentioned as likely to appear in the current volume, properly belonging in the series first mentioned above, have not yet been published. The series will, therefore, be continued next year. It is not possible to estimate just how much space a series of unwritten articles will occupy. The subjects remaining to be treated relate to the methods of observation with the microscope, and involve a description of some accessories, with instructions for using them.

Our readers may feel assured that next year the JOURNAL will be full of such interesting matter as will enable it to maintain its position as the leading microscopical journal in the country, and, we may repeat, the only one devoted solely to the encouragement and advancement of scientific study with the microscope, and published independently of any considerations of personal gain or business interest.

—O—

**NEW METHOD OF STAINING.**—The method of staining described by Dr. Councilman in this number gives results which, for the purposes mentioned, leave nothing to be desired. We would call the special attention of pathologists to this method as one particularly useful in tracing the course of degeneration in nerves. The method is a new one, scarcely known in this country as yet, although it has been employed by Dr. Councilman in the laboratory of Johns Hopkins University, where, a short time ago, we had the pleasure of examining some of the excellent preparations made in the manner described.

—O—

**SOME GENERAL REMARKS.**—The fifth volume of this Journal is drawing near the end, and it is with no little satisfaction that we can look back over the five years of its existence and see here and there signs of



continued improvement. We may be well content if it has been our privilege to give assistance and good advice to some of our many readers who use the microscope to unfold the beauties or the mysteries of the microscopic world.

It has not been our privilege to please all, but long ago we gave up any hope of doing things which experience had shown were not possible. Probably no man ever held the position of editor who gave universal satisfaction. From this thought we derive consolation.

Popularity, however, is not what we have been aiming at in conducting this Journal. While earnestly wishing for the advancement of knowledge in all directions, and in every branch of science, we have more than once given offence by withholding cordial support to popular movements when every consideration of policy and personal benefit clearly demanded a different course. Yet one must have opinions, and, without regard to their value in any particular instance, is it not more creditable for one to be actuated by convictions well considered rather than by any personal interests that may be at stake? Well, we have sometimes been rather outspoken, and have offended a few now and then who have, with what reason they themselves best know, given personal application, to themselves or others, to our very impersonal remarks; but, so far as we know, the world goes on about as usual, and so does our magazine—only it is improving all the time, and its circulation is increasing.

The point of all this is, that this Journal is conducted, as no other microscopical paper in this country is at the present time, purely in the interests of science and of persons engaged in scientific study, whether professional men or amateur observers. It is, therefore, absolutely independent. It is untrammelled by considerations of trade; its opinions are

freely expressed without regard to their influence upon the sale of any article or device that may be brought into notice. Its criticisms are well considered from the stand-point of experience, and in view of the numerous applications of the microscope, and not random attacks, indicative of restricted experience and narrow personal opinions.

These features have been recognized by some from the beginning of its career, and in five years they have given a character to the Journal in which we may well find satisfaction.

To the many contributors who have favored us with interesting articles for publication we extend our thanks, and to the still larger number of constant readers we can promise a coming volume full of interesting matter, and we trust they will all take early steps to secure the January number.

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TO SUBSCRIBERS.—The subscription-book for the ensuing year is already opened, and a few names have already been entered in it. This year the plan of requiring subscriptions to be paid in advance was adopted, and it has given such perfect satisfaction, and lessened the work of keeping the records so greatly, that we shall hereafter open a new subscription-list each year, and no names will be entered upon it until payments are made. The January number of 1885 will only be sent on receipt of the subscription-price. Sample copies will not be sent to old subscribers next year.

The terms of subscription will be the same as this year, viz., \$1.00 if payment is received before April 1, 1885, and \$1.50 if received on or after that date. These terms will be strictly adhered to. We have hardened our heart against the excuses or apologies based upon 'procrastination' or 'negligence,' both of which are reprehensible, and especially so when applied to such a small matter as the payment of one dollar deferred three months.

**CHOOSING OBJECTIVES.**—A correspondent in last month's issue asked for some information concerning homogeneous immersion objectives. His inquiries were, for the most part, met in an article published in the same number; but since the information desired is, perhaps, frequently asked for by persons who wish to purchase objectives, we will attempt to sum up the facts in this place. First, the writer refers to the cost of objectives of this class. It is true they are rather high-priced, but it should be considered that they are designed to accomplish certain kinds of work, and they should not, therefore, be compared in cost with other lenses that will not do the same work. The Hartnack water-immersion, at \$45, probably will not do what the Spencer homogeneous immersion, at \$55, will do, for the simple reason that its numerical aperture is smaller. Nevertheless, the Hartnack may be, and probably would be in this case, the better objective for the writer.

The whole matter, in a nut-shell, is this: A homogeneous immersion objective, of high numerical aperture, if well made, is an invaluable aid to microscopical investigations of certain kinds which require great resolving power for fine, close markings. The use of such objectives is very restricted, and, as a rule, they are not required in histological work.

For a power as high as a  $\frac{1}{8}$  or a  $\frac{1}{10}$  a well-constructed water-immersion lens (which may be adjusted to work also in glycerin if desired) will be found the most generally useful in the ordinary work of histology and common observation. Even for those refined studies of bacteria and disease-germs, which have attained such great importance at the present day, these objectives are to be most highly recommended. The impression that only oil-immersion objectives are suitable for such investigations is founded upon false notions, and failure to distinguish between the conditions of resolution of close markings and the

definition of minute, isolated particles or lines.

—O—

**POSTAL CLUB BOXES.**—The boxes were started on the circuits on the 18th of September, and may be expected to follow each other at the rate of two each month, every third box being one of Cole's series. We have received the following boxes:

Box C E. This is one of Cole's series, containing a transverse section of the stem of *Equisetum arvense* and of the root of *Taraxacum officinale*, with the usual descriptive text.

Box F 2 contains some excellent preparations,

1. *Orbitolites*. F. M. Hamlin. These shells, of a complex type of foraminiferal growth, show 'the various stages of growth and development from nautiloid or spiral to cyclical form.' The slide is described as a new one for opaque objects. It presents a very neat appearance, is light and strong. It is made of a piece of soft pasteboard. A half-inch hole is made in the centre with a gun-punch, the edges of the slide bound with colored tissue paper, a 3 XI paper label, such as the opticians have for covering slides, is pasted on the back, and a colored piece of paper for the bottom of the cell is fitted in. A brass curtain-ring is then fixed in the hole and the cover-glass is attached to it. Then the face label is put on and the work is done.

2. Endothelium. S. H. Gage. Stained with silver and carmine.

3. Developing germ of a tooth from a human embryo. A. M. Ross. Coupled with the careful description, this is a very interesting specimen. It is such preparations that are most valuable to the club, as they give information.

4. Proboscis, or 'tongue' of moth. John D. White. This slide is one of Mr. D. Folsom's preparations, which is a good indication of its excellence. Mr. White intends to replace it by another slide, which was not ready when his contribution was called for.



5. Transverse section of lung of a frog. C. M. Burgess. A stained section which, if it was well cut in the first place, has lost its value in the mounting.

6. Tentacle of jelly-fish. M. S. Wiard. Showing lasso-cells, nematocysts or stinging organs. This is an uncommon preparation, and is therefore of interest. It is a difficult object to preserve, and glycerin seems not to be the most desirable medium for it. Probably a mixture of glycerin, alcohol, and water would have preserved the soft tissue far better. Such an object requires something in the mounting fluid to harden it and prevent disintegration.

Box W, contributed by gentlemen of Camden, N. J., reached us Oct. 18th. It seems that the microscopists of Camden are either very industrious preparers, or else they make special efforts to have good specimens for the club-boxes. This box contains some preparations, which, taken in connection with the explanations of the letter-package, are exceedingly good.

1. Head and antennæ of the male moth *Argyia Leucostigma*. J. L. de la Cour. This is the moth which has threatened destruction to the trees in New York city, by feeding upon their leaves. The preparation is a good one of its kind, but how very much better it would be had it been mounted in a cell without pressure.

2. *Aspidiotus Coccus Gloverii*, orange scale insect. J. L. de la Cour. This preparation was remounted by Prof. S. H. Gage, as an accident had happened to it. It shows the scales well. The insect can be obtained from oranges by picking off the dark spots or scales, and Mr. Vorce adds a note to the effect that they make fine objects when mounted in balsam or damar by the carbolic acid method, when they will show the eggs in one end and the shrunken insect in the other.

3. Larva of the flea. Albert P. Brown. Some eggs were placed in a box, and in a few days the larvæ

hatched out. After nine days they assumed the pupa stage, and in a few days more the perfect fleas were found. Desiring to mount the eggs the preparer was not able to preserve them.

Mr. Vorce adds that he has used carbolic acid to kill eggs of lepidoptera for dry mounts. It does not affect their appearance.

4. Uric acid. Albert P. Brown. Deposited from urine in groups. A fine preparation.

5. Marine diatoms from Tampa Bay. C. H. Kain. Referred to in the article by C. Stodder in this JOURNAL, February, 1883.

6. *Heliopelta Ehrenbergii*. C. H. Kain. A series of seven specimens from the Nottingham, Md., deposit, showing variation in the size and number of rays in diatoms known under this name. The synonyme is given in the letter as follows:—

With 3 rays, *H. Metii*, Ehr., *H. Selliguerii*, Ralfs.

With 4 rays, *H. Leewenhækii*, Ehr., *H. Metii*, Ralfs.

With 5 rays, *Euleri*, Ehr., *H. Leewenhækii*, Ralfs.

With 6 rays, *H. Selliguerii*, Ehr., *H. Enterii*, Ralfs.

With 7 rays, specific name, if given, not known.

With 8 rays, specific name, if given, not known.

Specimens are rarely found with nine rays.

This slide will receive the attention of students of the diatoms. It is of especial interest in showing the great range in size as well as variation in markings.

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MICROSCOPICAL SOCIETIES.—Throughout the country there are numerous associations of microscopists meeting from time to time for the mutual benefit of their members. There are always a few leading spirits in each organization who have the responsibility of maintaining the interest in, and providing papers for,

the meetings. A microscopical society was formed last year in Washington, and has now a membership of over twenty-five, each member being engaged in some kind of microscopical work. At the two meetings which have been held this year at which we were present, an effort has been made to devise some plan whereby the value of the meetings can be enhanced, and also to assist members who may undertake special work. These matters have engaged our attention for a long time; we have always taken a deep interest in such efforts, and have watched the career of many microscopical societies with close attention. For some reason they are vigorous for a time, then they gradually languish and sometimes disband. There is scarcely an exception to this rule. Yet, the individual members continue to use the microscope, and find enough to interest them in what they see. Why is it, then, that the societies lose their support?

It is not an easy question to answer. Carefully as we have thought over the matter, we are still uncertain about the conditions of success or failure. Some facts are patent to the most careless observer. One cause of the lack of interest can sometimes be pointed out at once. It is the excessive amount of unnecessary business that is brought before the meetings. Some one who has the interests of the society at heart devises a comprehensive scheme designed to increase the interest in the meetings, and, with the best motives in the world, presents the matter at length. Then it must be considered in open meeting, each section discussed and voted upon, and the time of adjournment comes before any of the society's proper work is done. Members go away disappointed, and thus endeth the first stage.

Going on a step further, suppose the scheme proposed has been fully elaborated and approved. It is then found, as is almost sure to be the case, that it is impossible to carry it

out. No provision has been made to enforce its regulations; it is nobody's business to do so, and, moreover, it is such a complicated affair that nobody but the proposer fully understands it; and, on the whole, it is to a great extent impracticable. Then it requires further modification, involving longer discussion, interruption of the legitimate work of the meetings, and annoyance all around. Nobody blames the proposers and advocates of the scheme, nobody finds fault, knowing the motives which have actuated them; yet some members conclude that it is not worth while to attend the meetings until such matters are settled. This is the beginning of their loss of interest and irregular attendance.

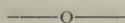
It is true that in the organization of a society there is a certain amount of preliminary business to be done. Rules for its proper government must be adopted, times for meeting appointed, and order of proceedings arranged. This, however, should be carefully thought out by the promoters of the organization, and presented in a good form for consideration in the shortest possible time. The simpler the rules are the better the society will flourish. It is true that the constitution and by-laws of the New York Microscopical Society, in the preparation of which we took an active part, are not so simple as we would generally advise. The conditions in a large city like New York, however, are quite different from those which prevail in other places.

Passing now to regulations proposed to systematize the scientific work of a society, it may be said that, so far as our experience has shown, such regulations are of very little value. They are sure to exact more from some individuals than those persons feel competent to perform. It is impossible to conduct a scientific society like a machine, nor will the members come forward with essays or reports of progress on sub-



jects assigned to them. It may seem a simple matter for a person to compile an essay on a particular subject suggested by a committee as a subject of general interest for instruction or discussion. No doubt every member of the society could do such work well, but many will not, because of diffidence or want of inclination.

In a nut-shell—for we must defer further consideration of this subject until next month—if the promoters of a society desire to make its meetings of interest, and have faith in its continued prosperity, they must first depend upon their personal and long-sustained efforts to get it firmly established. If they can make the meetings of value and interest to the members, success will be assured.



**STUDIES IN MICROSCOPICAL SCIENCE.**—We learn from a circular recently received, that the third volume of Mr. A. C. Cole's 'Studies in Microscopical Science' is to be published under the editorship of Mr. Cole, but the publishers are J. G. Hammond & Co., Birmingham, and Ballière, Tindall & Cox, London.

It is pleasing to know that this very instructive and valuable work is to be continued. Mr. Cole, with conscientious devotion to his work, and regardless of the continued losses which its publication entailed, fulfilled his promises to the letter, and completed two volumes. We are safe in saying that Mr. Cole has thereby subjected himself to a loss of not less than \$3,500.00, a considerable portion of which would have been saved had he stopped the publication at the end of the first volume. This he would not do, but preferred to keep his agreements even at an unreasonable sacrifice. The work in Mr. Cole's hands has not been even reasonably, far less adequately, supported.

It is unfortunate for the few conscientious and self-sacrificing work-

ers for the general welfare of mankind, who fondly think the best things are sure to be received and supported for their intrinsic merit, that they are so often doomed to disappointment. No matter how well and conscientiously one may endeavor to do a creditable and worthy thing, from the highest motives, disappointment is likely to follow. The best motives, the most conscientious efforts, as many have experienced, are likely to meet with but little encouragement, and may be subject of adverse criticism, abuse and ridicule, even by persons in positions of responsibility and honor—for such places are occasionally filled by persons by nature and want of culture unfitted for the stations where the accidents of life have placed them. Mr. Cole has not failed to receive high praise and commendation for the excellence of the 'studies,' but the practical encouragement which he has so well deserved has been withheld, or at least not freely given.

We trust that the new publishers who begin the third volume will find it profitable. They possess great advantages over a private individual; and we have not the slightest doubt that, with the prestige of the two volumes already published, and the well-known character of the work, they will find it not unprofitable.

There will be four sections with 12 slides each, published during the year, for £4, or either of the single sections, devoted respectively to 'Botanical Histology,' 'Animal Histology,' 'Pathological Histology,' and 'Popular Microscopical Studies,' for £1 5s.

Subscriptions and correspondence may be addressed to either of the publishers, or to Mr. Cole, St. Domingo House, Oxford Gardens, Nottingham Hill, London.

We trust the third volume will receive adequate support, and that many subscribers will be found in this country.

## ZINC WHITE CEMENT AGAIN.—

A correspondent relates some facts concerning the use of zinc white cement, in another column, which are strongly confirmatory of the opinions that have been several times expressed by ourselves. The same testimony has been given by many others; and in some cases when persons have called in question the accuracy of our previous assertions concerning this matter, we have been able to convince them that we were in the right by looking through slides in their own cabinets. We have not at any time stated that zinc white cement never proves satisfactory, for it would be strange indeed if some mounts made with it should not remain perfect. What we have said, and still maintain as the result of practical experience, is that zinc white cement cannot be depended upon. It may do as a finish, but not for the practical purposes of a cement.

We refer to the subject at length because of its importance to every mounter, but we are especially led to bring it prominently forward again because a certain writer in St. Louis has recently recommended its use. Now, it is impossible for us to believe that the author in question was not aware of what we had said concerning this cement, yet he deliberately tells his readers to use it, without so much as a hint that it has been declared unreliable. We do not expect that every reader of this paper will rely absolutely upon the opinions expressed in these editorial columns—far less those whose experience has been such as to give them undue confidence in their own judgment and wisdom. Nevertheless, even though an individual has used zinc white successfully for years, the experience of others should have some weight; and any person who assumes to give instruction without regard to the experience of others, pursues a course of injustice to all and discreditable to himself.

Fortunately, most of our readers

know very well that nothing finds its way into these columns that is not from a good source and worthy of confidence. We are endeavoring to do all we can to assist microscopists, and we do not like to see others try to undo it, even though they may write with the best of motives—which we fear is not always the case.

## NOTES.

—We have just received a preparation of the *Bacillus tuberculosis*, prepared strictly in accordance with the method given in the preceding number of the JOURNAL, which is far superior to any preparation of the kind we have ever seen. It was prepared by Dr. J. C. McConnell, of the Army Medical Museum, and shows the bacilli in great abundance and with remarkable sharpness. Not one of the German preparations we have seen is equal to it; in fact, we did not suppose it possible to get such a fine definition of the organism as this mount affords.

—We trust that readers do not neglect to keep a close watch of the advertising pages from month to month, as new articles are being constantly offered for sale, and it frequently happens that the supply of some of them is not large, and therefore it is soon exhausted. This month Messrs. Walmsley & Co. have changed their advertisement throughout. Mr. Emmerich offers a very full line of Zeiss' objectives, just received. It will also be noticed that he has made a change in his business by taking his son as a partner in the firm of Fr. J. Emmerich & Son. Mr. J. L. Zabriskie is offering some sections of wood of American trees, and Mr. Hinrichs, of Baltimore, has received a new supply of Marpmann's preparations.

—We have already drawn attention to the 'Harvard' microscope stand devised by the Bausch & Lomb Optical Company, which was made to meet the demands of those who desire stands of the continental pattern. On enquiry we learn that the demand for these microscopes has been quite large, and it appears there is a place for them, as was suggested in these columns long ago. Those who desire instruments of the kind can now obtain them from home manufacturers. We have an article about microscopes awaiting publication next month, which intending purchasers may read to advantage.



—We have received a few excellent mounts of late which deserve to be mentioned in this place. From Miss M. A. Booth we have a dry mount of scales from a mosquito which are so evenly distributed over the field that we are tempted to ask her how it was done, and to request an answer for the benefit of our readers. She has also favored us with a fine preparation of *Tabellaria flocculosa*, a common diatom, but a good one to mount.

Mr. E. G. Day has sent us some specimens of the preparations he has been offering for sale in our advertising columns. They are well mounted, and doubtless many of our readers have already obtained some of them.

From the histological laboratory of the University of Pennsylvania we have received sections of the lung of an ox, and of the mammary gland of a cat, and transverse sections of a dog's lip, and of human sciatic nerve. The preparer's name was not given on these.

—In an interesting communication to *Zoologischer Anzeiger*, Lud. Plate describes some features in the structure of the rotatoria, particularly the genital organs and nervous system, and the process of fertilization. In closing, the author remarks that the assertion that rotifers can withstand dessication is not true, and states that many of them die in a short time when they come in contact with the air on the surface of the water.

—Mr. W. H. Bulloch informs us that he is constructing a microtome for cutting sections in ribbons, which shall embody the best features of the various foreign instruments in use and some of his own devising in addition. Mr. Bulloch's well-known ingenuity will no doubt enable him to produce a microtome that will be, as he hopes, superior to all others.

—We have received an unusually excellent photograph of members of the American Society of Microscopists taken in a group at Rochester, by Messrs. Bowditch and Hoagland, of that city. The price of the prints, mounted on cards 20 by 24 inches, with a 'key' which gives the name of each person in the group, is \$2.00; unmounted prints are \$1.75 each. This is a very interesting card for microscopists, as the portraits are all good, and many of them are of persons known well by name to every microscopist.

—The next meeting of the American Society of Microscopists will be held in

Cleveland, Ohio, by invitation. The microscopists of that city will endeavor to make the meeting pleasant and in every way successful. They have ample time for preparation.

—We learn that Dr. Sternberg is having some enlargements of his photomicrographs of bacteria for the New Orleans Exposition, which opens in December. The enlargements are being made at the Army Medical Museum. It is a severe test of a negative to produce large pictures from it, and we should hesitate very much about subjecting a negative from such difficult specimens to represent by photography as Dr. Sternberg has studied to such a process. We trust, however, that the results will prove creditable to him, who is deserving of much credit for his painstaking work.

—The Baltimore Microscopical Society seems to be in a flourishing condition. Its meetings are now held at the Johns Hopkins University, and Dr. Councilman has been elected president for the current year. Among the members are a number of well-known microscopists, Dr. G. M. Sternberg, who is conducting his researches in the university laboratory, Dr. L. M. Eastman, whose extensive cabinet of slides is already famous, and others of whom we shall doubtless hear from time to time through their contributions to these pages.

—It is surprising to notice the extremely low price at which books are now published, dependent, to be sure, upon a very large demand. From a circular of John B. Alden, of 303 Pearl street, New York, author of the 'literary revolution' which attracted much attention about three years ago, we learn that the work of publishing cheap editions of valuable works still continues. A monthly magazine, *The Book-Worm*, is published for 25 cents a year, which is full of interesting reading; another monthly, *Choice Literature*, much larger and more solid in the character of its reading matter, is \$1.00 a year. As for books, Guizot's 'History of France' is sold in 8 small octavo volumes for \$7.00, with 426 full-page illustrations. This work, in its original form, was sold at \$50.00. Rawlinson's 'Seven Great Monarchies of the Ancient Eastern World' is offered for \$2.75. A catalogue of 100 pages will be sent to any applicant, and those who are not acquainted with the 'literary revolution' will do well to look over the catalogue.

—Mr. W. P. Collins has issued his 'Catalogue of scientific books, mostly second-hand,' No. 13, 1885, which includes a long list of books on microscopical subjects, many of which are rare. In this connection we may also call attention to the slides of insects prepared by Mr. Chas. Collins, Jr., which are sold in sets of one dozen for half a guinea. These are mounted without pressure, and are highly spoken of.

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## CORRESPONDENCE.

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### An Unknown Plant.

TO THE EDITOR:—A short time ago Mr. Wolle kindly sent me a small vial of desmidaceous material, and in looking over it lately I have discovered a curious little alga, which I cannot make out. I send a sketch of it. I have looked over all works available likely to throw any light on it, but can find no drawing or mention of anything like it. It is very minute, the sketch being drawn under about  $\times 680$ . What can it be? Can any readers of your JOURNAL kindly say?

E. H. WAGSTAFF.

BIRMINGHAM, England.

[The sketch enclosed by our correspondent was sent to Mr. Wolle, who was unable to identify it without further information. The color should have been stated, as it is an essential character. If green the plant might be a fruiting filament of *Cylindrocapsa graminella*, Wolle; if æruginous, which is more likely, it might be a sporiferous filament of *Anabena*. As the determination is uncertain, the sketch is not reproduced.—ED.]

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### Parasite of a Grasshopper.

TO THE EDITOR:—The worm taken from the grasshopper by Mr. E. G. Day was probably *Mermis albicans*, a hair-worm parasitic upon grasshoppers, etc. It sometimes grows to the length of thirty inches before quitting its host. Mr. Day will find the life-history of his capture in The First Annual Report of the United States Entomological Commission, p. 326, *et seq.*

D. N. DE TARR.

BOONE, Iowa.

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### White Zinc for Mounting.

TO THE EDITOR:—In looking over some sixty slides withdrawn from circulation and placed in the reference cabinet of the American Postal Microscopical Club, I found that 27 of the preparations

had been sealed with the celebrated zinc white cement.

Of these 27 slides, 21 required re-cementing, and in every case the cement was so brittle that it needed but a touch of the knife-blade to cause the fragments which remained to leave the glass. I am perfectly well aware that circulation for a year or more through the circuits of the club is a very severe test for a cement, and I do not doubt that many of the slides would have been in better condition if, during the same length of time they were travelling about the country in the boxes of the club, they had, instead, been lying secure in a cabinet. But it is a notable fact that every other cement used seems to have stood the trial better than the zinc white. I have excluded from consideration in every case slides that were broken or in any way injured in the mails. The other cements used were chiefly shel-lac, Brunswick-black, and a brown cement which looks like marine glue. These have all seemed to stand well. I had to repair but one shel-lac ring out of some eighteen specimens. If you wish to publish these facts for the benefit of the readers of your JOURNAL you have my consent to do so. You have spoken in the JOURNAL once or twice about this cement, warning microscopists not to rely too much upon its supposed virtues, and it was this fact that caused me to think that you might value the facts given above.

C. E. HANAMAN.

TROY, N. Y.

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## NOTICES OF BOOKS.

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*Diatomaceerna i Kützings exsikkatverk: Algarum aquæ dulcis Germanicarum Decadeo*, Af N. G. Lagerstedt. Öfversigt af Kongl. Vetensk. aps-Akademiens Förhandlingar, 1884. No. 2. Stockholm. (Pamphlet, pp. 35, with 1 plate.)

The species are described in Latin, and the synonymy is quite fully given for each one.

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## Exchanges.

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[Exchanges are inserted in this column without charge. They will be strictly limited to mounted objects, and material for mounting.]

Fossil Diatomaceous Earth, (a new find), very interesting forms for other material.

J. WALKER,

810 Twelfth Ave., South Minneapolis, Minn.

Wm. R. Mandeville, M. D., of New Orleans, La., 483 Magazine street, has for exchange or sale a number of first-class mounts of pathological specimens, including yellow fever and leprosy; also a large number of miscellaneous objects.



# THE AMERICAN MONTHLY MICROSCOPICAL JOURNAL.

VOL. V.

WASHINGTON, D. C., DECEMBER, 1884.

No. 12.

## Schröder's Camera Lucida.

Although mention has several times been made of this instrument in these pages, we have not yet described the precise construction of the prism. It is figured in the cut (Fig. 29), which shows the course of the rays of light and the angle at which they enter the prism from the paper.

The eye is supposed to be located at *K*, immediately above the prism, looking directly downward at the drawing-paper and pencil, in the direction *KJ*, the sides *DE* and *BC* being parallel. The pencil point is, therefore, seen as clearly as it would be through a plain piece of glass.

The image from the microscope is received on the face *FC*, the stand being inclined at an angle of  $45^\circ$ . The rays, being totally reflected from the surface *EF*, are received on the face *DG* of the upper prism, which is separated from the lower prism by a thin film of air. From thence the rays pass to the eye, and the images of pencil, paper and object on the stage are received by the eye together.

When the light is properly adjusted this instrument leaves nothing to be desired; pencil, drawing and object are distinctly seen, and the light is easily managed. This instrument is manufactured by Messrs. Ross & Co., of London, and Mr. Walmsley some time ago told us he would soon have some of them in stock. The prism, as some readers will recognize, is the same as was first applied by Mr. Wenham as a binocular prism

for microscopes. Not many of those prisms were made for that purpose, however, probably owing to the difficulties of construction.

While commending this instrument in the highest terms, it is but fair to say that, owing to the considerable

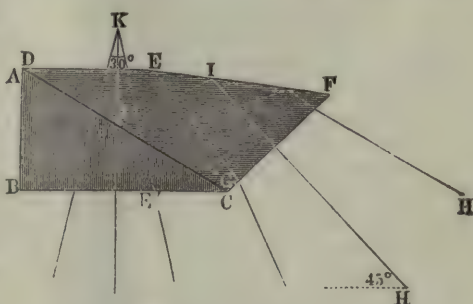


FIG. 29.—Schröder's Camera Lucida.

distance the light has to travel through it from the eye-lens, it can only be used with oculars of low power, having a long focus back of the eye-lens. Otherwise the rays come to a focus within the prism, or at least do not reach the point *K* far enough above the prism to afford a sufficiently large field of view. This fact will greatly restrict the use of this otherwise most excellent camera lucida.

No such objection applies to the camera lucida of Grunow, which is the only one comparable with it. In fact, after showing the Schröder instrument to a well-known microscopist who was constantly using Grunow's form, he was quite unwilling to admit that either form was superior to the other as regards the clearness with which the image and pencil can be seen together.

## Electric Light for the Microscope.

An article upon this subject was promised some time ago, but in the

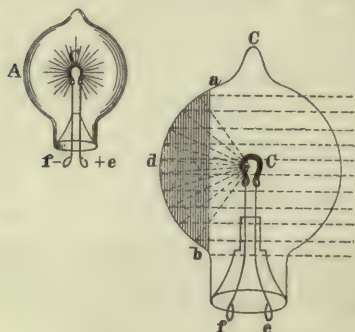


FIG. 30.—Incandescent Lamps.

hope of having an opportunity to test the qualities of the incandescent lamp in practical work we have deferred its publication until now. We are still unable to add any results from our own experience, but hope to supplement the present article with such observations before long. The cuts illustrating

this article have been copied from the *Zeitschrift für Mikroskopie*, where the apparatus is more fully described.

In Fig. 30 are represented the incandescent lamps as provided for this purpose by Müller, in Hamburg, of natural size, or only slightly reduced. In these the ordinary carbon filament is replaced by a spiral of platinum wire, which is heated to incandescence by the electric current. These lamps may be made of common glass, or, to modify the light, of opal glass. The manner of attaching the lamps to a microscope is shown in the elaborate arrangement in Fig. 31. The larger lamp serves for opaque objects, the smaller is beneath the stage. A system of wires passes beneath the microscope, which affords a means of regulating the strength of the current; but this part of the arrangement need not be described.

It is said that the current from two Bunsen or Grove cells of 20 cm. height, or two Grenet's cells, such as that shown in Fig. 33, will serve to light these lamps. We are not told, however, how long the necessary current will be sustained without changing the material in the cells.

The lamp may also be mounted on a separate support, such as is shown in Fig. 32.

One feature of the arrangement shown in Fig. 31 deserves especial notice. In the stage, beneath the object, there is a spiral of platinum (B), which becomes heated when the current is allowed to pass through it. The heating can be perfectly

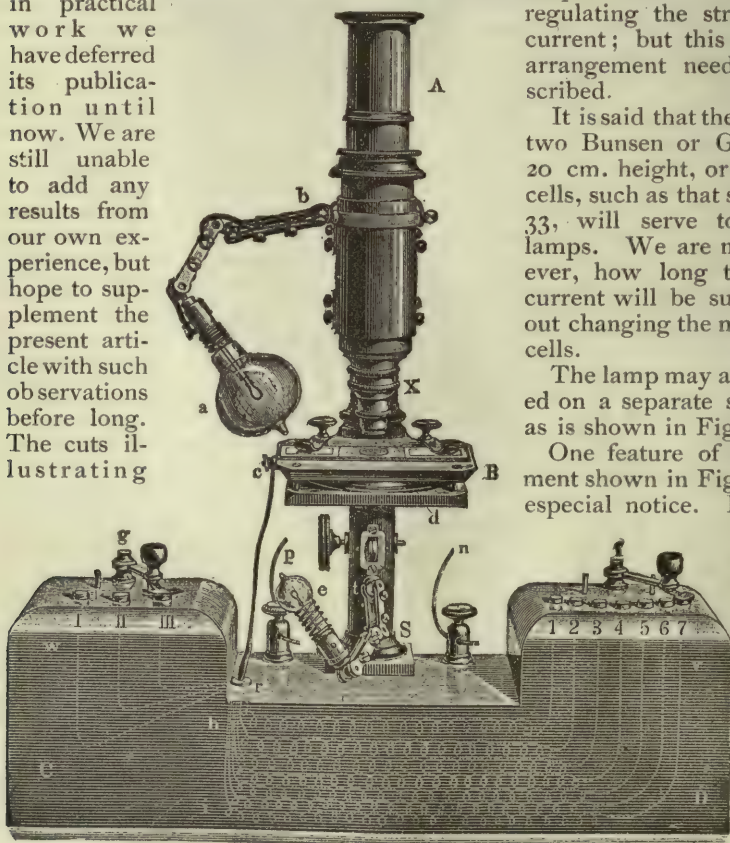


FIG. 31.—Microscope with Electric Light.



regulated by controlling the current. The air, which passes upward through the opening in the stage, is thus heated, and conveys the heat to the

object on the slide by convection. For a warm-stage this seems to be the most convenient device yet suggested. A metal thermometer can be placed between the heated spiral and the object, so that the temperature can be read off at any moment from the scale; or

FIG 32. Electric Lamp Stand a thermo-electric arrangement can be applied for the same purpose, a galvanometer needle then indicating the temperature.

In Fig. 33 is shown what seems to be a very convenient application of electricity for photographing objects. Only one battery-cell is shown, but we infer that two are used in practice. The lamp is of  $1\frac{1}{2}$  or 2 Volt's tension, and two such elements will suffice to give it an intense white heat. The lamp can be moved up and down on the mirror-bar, according to the illumination required. The photographic camera is attached to the microscope by the screw c.

For low

powers, of 20 to 100 diameters, an exposure of 15 to 20 seconds suffices when dry plates are used, the correct time being easily learned by experiment. When higher powers are used even 10-12 minutes may be required, and several trials must be made to determine the proper exposure.

The electric light has already been used considerably in microscopy, and, in fact, by a few persons for a number

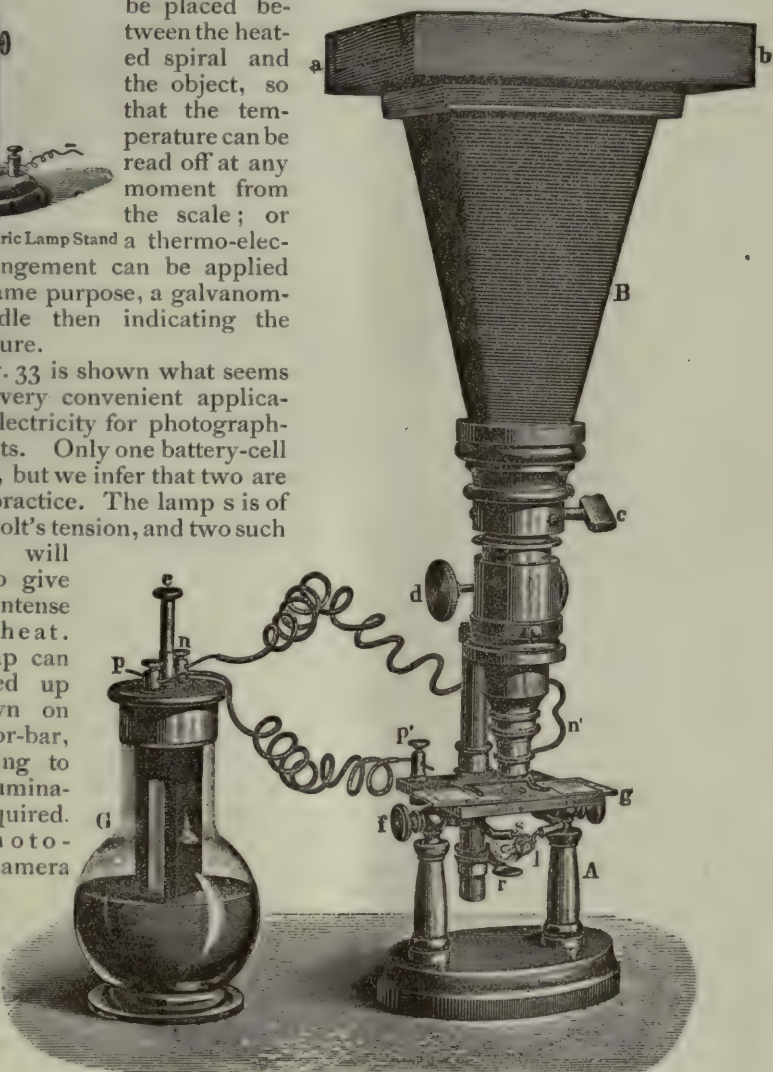


FIG. 33.—Photography with Electric Light.

of years. The matter in this article has been mostly drawn from a contribution to the *Zeitsch. für Mikr.*, by Dr. T. Stein. In a later number of the same valuable publication Dr. Henri Van Heurck has severely criticised Dr. Stein for omitting due reference to Dr. Van Heurck's own experiments and observations on the subject.

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### Chromogene Bacteria.

Among the numerous species of colored organisms classed among the bacteria are some which are very common, and as their culture may be carried on with very simple apparatus, such as can be readily arranged by any one with the conveniences always at hand, their study offers a good field for observers who have the time and inclination to give it attention. There is also offered a promising field for original work, since there is still much to be learned before the life cycles of these forms will be fully known.

In times past the sudden appearance of colored spots upon cooked articles of food has given rise to much excitement among superstitious persons. The so-called 'blood' which has occasionally appeared mysteriously on bread, potatoes, etc., has doubtless been the *Micrococcus prodigiosus*, which has a bright red color.

The genus *Micrococcus* is the only one belonging to Cohn's family of bacteria. The Spherobacteria, characterized by the spherical form of their cells, which are always motionless. They are bacteria that produce fermentation, and not putrefaction.

The genus *Micrococcus* is divided into three groups, viz., the chromogenes, zymogenes and the pathogenes. The first are micrococci producing colored pigments; the second are ferments of various kinds; the third are associated with diseases, as *M. septicus*, and the micrococcus discovered by Salmon which is the cause of swine-plague, of which we have an

excellent and pure preparation. It is only of the chromogenes that we have now to speak.

During the meeting of the American Association at Philadelphia we visited the laboratory of Dr. Formad, where he was cultivating, among other things of the same nature, several of the chromogenes, among them *Micrococcus prodigiosus*, *M. luteus*, and the species known to the Germans as Rose-hefe, of which we have not yet learned the scientific name. Dr. Formad was good enough to place a small quantity of each of these on a slip of filter paper, which we pocketed and brought home to Washington. This was the seed from which we have raised some fine cultures.

It may be asked why we should have desired such specimens to start our cultures with when we are told in the books that all one need do to obtain them is to expose a proper nidus for their development—a slice of potato, for example—to the air, when the spores will find their way to it and grow. Well, the reason was that, although occasionally a few stray spores of the species desired may be caught in this way, the probabilities are that before the particular ones sought are caught the potato will be covered with something totally different—most likely *Bacillus subtilis*, which is always about, and such a rapid grower that it soon covers everything it can live on.

It is a very easy matter to obtain cultures which will exhibit to the naked eye the characteristic colors and appearance of these organisms, but to obtain them microscopically uncontaminated with other species requires more care. We will first describe the apparatus we have used for this purpose, and afterwards the precautions to be observed in making absolutely pure cultivations. Any of our readers who may desire to obtain some of the spores to experiment with can do so by sending a stamped and addressed envelope to the editor. We can supply *M. luteus* in any



quantity, and hope soon to have a like abundance of *M. prodigiosus*. It will be sent on a piece of paper, and the best way to start a culture is to touch the paper to the surface of a slice of boiled potato, or hold the paper above the latter and scatter some of the material over the potato by means of a needle heated to sterilize it in the flame of a lamp. The paper may also be soaked in a few drops of water and the needle be dipped into the water and transferred to the potato several times. In this way the spores can be transferred to the potato, but there is rather more danger of contamination from other bacteria in the water.

The best method of obtaining pure cultures of bacteria is to grow them on a solid substratum such as sterilized gelatin, or potato. Inoculating the medium at various points with a needle as already described, the species will grow from the different centres. From the young growths further inoculations can be made in the same way, and finally absolutely pure growths are obtained. These can then be cultivated in fluid media if desired. The reader should refer to the article on this subject published on page 185. The forms of culture tubes used for fluid media by Dr. Salmon and Dr. Sternberg will be figured next month, the cuts not being ready for this issue.

The simplest arrangement that can be devised for a culture-chamber is a glass tumbler inverted over a saucelish containing water, with a salt-cellar projecting above the water to support the specimen. If a large bell-glass is at hand it is still better, as it will receive several specimens.

Most of the species will grow well on boiled potato, and it is only necessary to cut a slide about one-quarter of an inch thick, touch it with a needle carrying the spores, place it under the glass, and in a day or two abundant growths will be obtained. A small portion placed under a microscope will show the characteristic

spherical cells of the micrococcus. A high-power objective must be used, however, as the cells are exceedingly minute—nothing less than a  $\frac{1}{16}$ -inch will show them clearly, and a  $\frac{1}{8}$  is desirable.

To distinguish the cells clearly they should be prepared by staining and mounting in water. They stain readily with anilin colors, especially with methyl blue, which is the color we have used for the purpose. The process of preparation is as follows: Having obtained a good growth on the potato, prepare a clean slide and cover-glass, put a drop of water on the slide, take a small portion of the gelatinous growth on the point of a sterilized needle, transfer it to the drop of water, and dry slowly over a lamp. When thoroughly dry, cover the deposit on the glass with a strong aqueous solution of the anilin color, and in two or three minutes wash it off with water. The preparation may then be examined in water or glycerin. We are accustomed to use a Spencer  $\frac{1}{8}$ -inch objective in this work, with an Abbe condenser.

The precautions to be observed in preparing the culture-medium will depend somewhat upon the purity of the atmosphere, or its freedom from spores of various kinds. We have succeeded very well by merely cutting a boiled potato, while still warm, with a knife-blade sterilized in a flame, and immediately placing the pieces under a bell-jar. If, however, it seems desirable to sterilize the potato, so as to ensure absolute freedom from contamination, it may be done in a manner described to us a short time ago by Mr. Theobald Smith. The slices are placed in a solution of corrosive sublimate, 1 part to 1,000 of water, which kills all spores that may be present. The slices are then steamed, and the condensed steam carries away the mercury salt, and whatever is planted will be sure to grow without danger of being overrun with other species. The advantage of the corrosive sublimate is that it not only

kills the organisms that may be present, but also the spores which, in some cases, are not killed by boiling. For this reason we have been led to experiment with baked potatoes, as it is probable that no spores can withstand the temperature of an oven when potatoes are baked. The result has been eminently satisfactory so far as cultures of *M. luteus* are concerned. The potato may be baked, placed under a bell-jar which has been heated in the oven until thoroughly sterilized, and there is not much danger of contamination.

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### Notices of New Fresh-Water Infusoria.—II.

BY ALFRED C. STOKES, M. D.

#### *Opercularia plicatilis*, sp. nov.

Body elongate-ovate or somewhat conical-vase-shaped, smooth, soft and flexible, the length two and one-half to three times the width; when extended constricted beneath the peristome border, widest in front of the middle, tapering and attenuate posteriorly; when contracted broadly ovate-pyriform or subspherical, thrown into transverse folds posteriorly and bearing anteriorly a snout-like, crenulated and longitudinally plicate projection; parenchyma of the body and ciliary disc enclosing numerous green corpuscles, that of the peristome border and posterior one-third of the body usually colorless and finely granular, the cuticular surface of the latter part finely striate lengthwise; peristome border as wide as the body, somewhat everted, the margin crenulate; ciliary disc considerably and obliquely elevated; ciliary circles two; membranous collar large and conspicuous; pedicle rigid, finely striate longitudinally, dichotomous, or umbellate with three or more branches, and gradually increasing in thickness from the point of attachment to that of division; zooids attached in sessile clusters of from ten to twenty members; nucleus band shaped, curved, transversely placed anteriorly; contractile vesicle

single. Length of extended body  $\frac{1}{10}$  inch; height of entire colony  $\frac{1}{20}$  to  $\frac{1}{10}$  inch. Habitat.—Pond water; attached to *Ceratophyllum* and *Anacharis*.

These colonies are comparatively so immense in size that they are apparent to the unaided vision. They occur in some profusion on the leaflets of various aquatic plants, the zooids there forming subspherical clusters about  $\frac{1}{8}$  inch in diameter. The foot-stalk, stout, erect and rigid, presents two distinct methods of division: simple furcation into two approximate branches as in figure 1, and a trifold or quadrifold umbellate formation with the branches bifurcated or not, as in the diagram (Fig. 2.) Which form shall be selected seems to depend upon the vital activity, and consequently the uncomfortably crowded condition, of the zooids.

In the contracted phase the posterior transverse annulations closely resemble those characteristic of *Epistylis plicatilis* Ehr. when in the same state, and suggested the specific name. They, in connection with the anterior snout-like projection, with the distinct marginal crenulations and the conspicuous longitudinal plications, readily distinguish the species from all other members of the genus.

In Fig. 1 is shown a small colony with the most usual form of foot-stalk; in Fig. 2 the comparatively rare umbel-like division, while Fig. 3 exhibits a contracted zooid and Fig. 4 the characteristic parts of an extended individual. The quadrifold division of the foot-stalk seems very uncommon.

A method of multiplication for the dissemination of the species is by the subdivision of the body into several subglobose or pyriform parts, each bearing a subcentrally located ciliary girdle. At times one of these migrant zooids attaches itself to the primary foot-stalk of the colony and secretes a long narrow individual pedicle, thus complicating the animal-



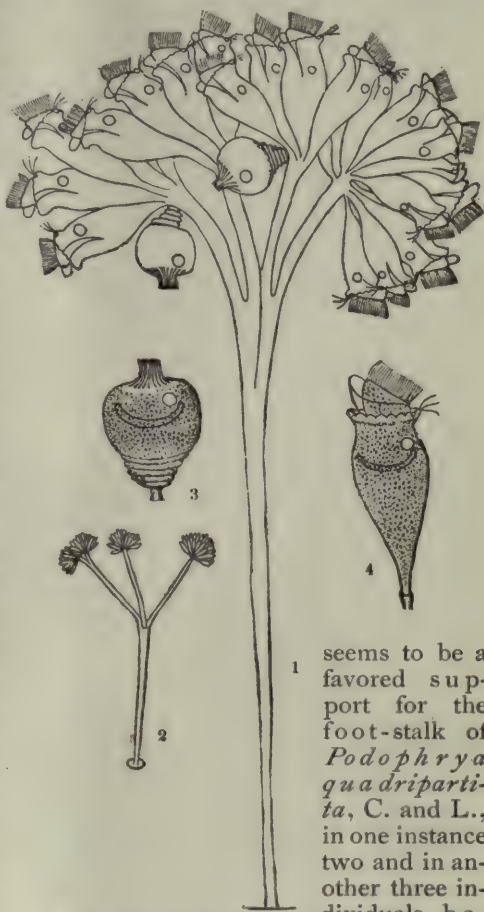
cule's somewhat irregularly branching habit.

*Epistylis vaginula*, sp. nov.

Extended body elongate-conical, soft and flexible, twice as long as broad, peristome widest, beneath which is a slight constriction whence the body gradually tapers to the footstalk; cuticular surface finely striate transversely; parenchyma colorless, minutely granular and enclosing small green food particles; peristome border thickened, slightly everted; ciliary disc elevated; nucleus band-shaped, transversely placed in the anterior body-half; contractile vesicle beneath the peristome border; contracted body globose or subpyriform, with a small, snout-like anterior projection, and occasionally thrown into several annulations posteriorly, the extremity always sheathing the distal end of the pedicel; foot-stalk dendriform; profusely and dichotomously branching, finely striate longitudinally, irregularly articulate or not, the primary pedicel about twice as long as the branches which are of a nearly uniform length and are closely approximated. Extended bodies  $\frac{3}{16}$  to  $\frac{5}{16}$  inch long; height of entire colony  $\frac{1}{16}$  inch. Habitat.—Pond water; on *Ceratophyllum*.

The pedicel, in its manner of branching and in the comparative length of the main stem and divisions, resembles that of *Epistylis flavicans* or the beautiful *Dendromonas virgaria*. The conical form of the zooids, however, and the transverse placing of the nucleus readily distinguish the species from *E. flavicans*. The posterior annulations of the contracted animalcule are neither characteristic nor constant. They are more or less common with many members of the genus, and, when somewhat modified, are used as a distinctive feature of specific import with *Epistylis plicatilis*; but the peculiar formation of a sheath over the end of the

foot-stalk by the extremity of the contracted body is characteristic and of diagnostic value, and it was this little sheath that suggested the specific name. The pedicel, in common with that of several species of the genus,

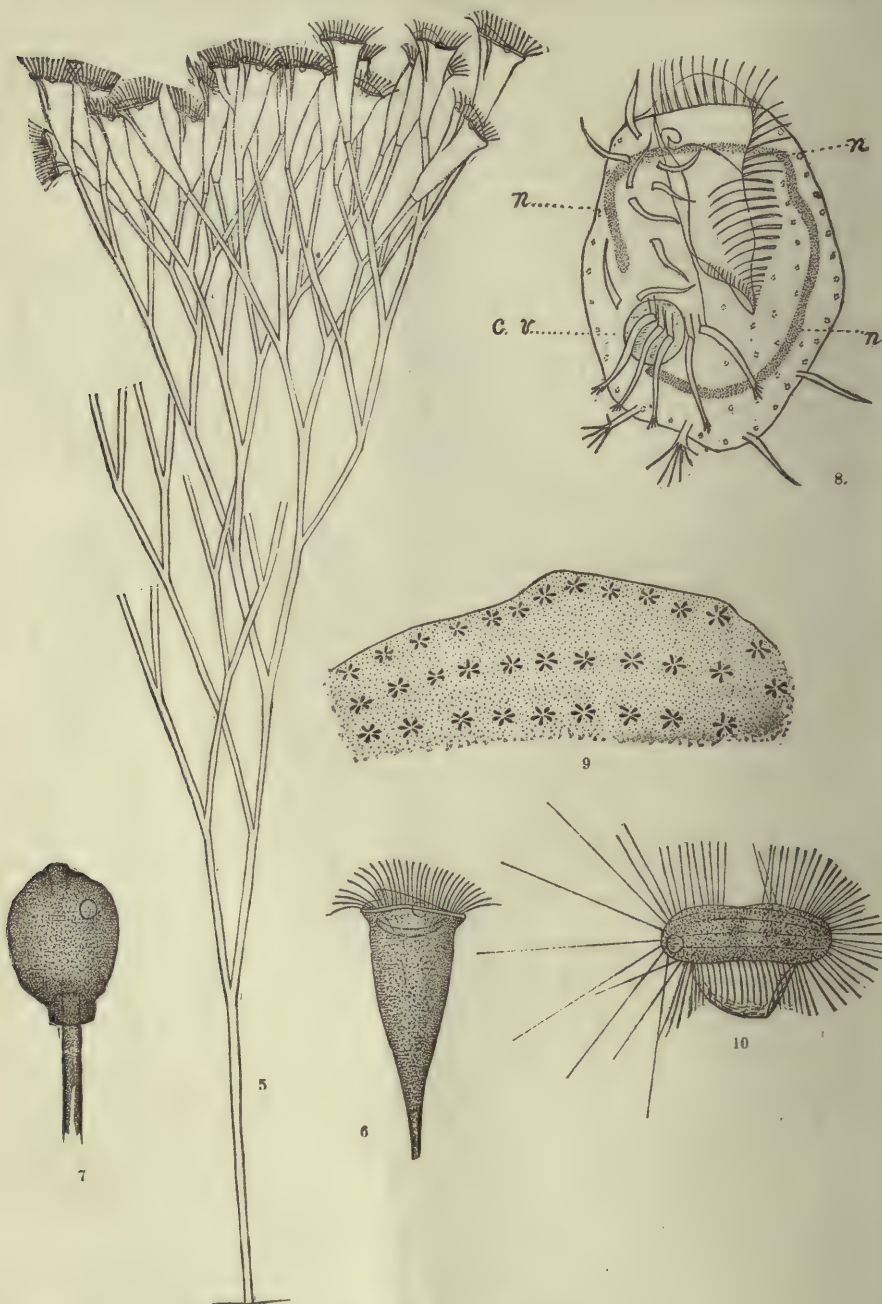


1 seems to be a favored support for the foot-stalk of *Podophrya quadripartita*, C. and L., in one instance two and in another three individuals being

observed attached to the luxuriant pedicel of a single specimen.

The cuticular striations are not conspicuous. It is only under favorable circumstances or after manipulation of the light, that they usually become noticeable.

Only a small portion of a mature colony is shown in Figure 5; in Figure 6 the extended, and in Figure 7 the contracted zooid are delineated.



## EXPLANATION OF FIGURES.

- FIG. 1. A small colony of *Opercularia plicatilis*.  
 FIG. 2. The less common, tripartite form of the same.  
 (Diagram.)  
 FIG. 3. A contracted, and, FIG. 4, an extended, zooid.  
 FIG. 5. A small portion of a colony of *Epistylis vaginula*.

- FIG. 6. An extended, and, FIG. 7, a contracted, zooid of the same.  
 FIG. 8. *Euploes plumipes*, ventral aspect.  
 FIG. 9. The ornamentation of the external surface of the carapace.  
 FIG. 10. *Cyclidium isomesum*.



*Euplotes plumipes*, sp. nov.

Carapace irregularly suborbicular or elliptical, the right-hand body-half much thickened, the anterior margin truncate, often minutely crenulate or beaded, the upper lip crescentic and conspicuously projecting; posterior margin rounded, usually with a shallow emargination on the right-hand side of the median line; right-hand border rounded, or somewhat flattened and undulate; the anterior and posterior halves of the left-hand border commonly obliquely truncate in opposite directions and forming centrally a projecting and rounded angle or keel-like protuberance; peristome field wide, triangular, the upper right-hand corner prolonged in a sinistrally directed helicoidal curvature, posteriorly extending beyond the centre of the ventral surface, the cilia of the anterior and left-hand borders large and cirrhone, the posterior portion only of the right-hand margin bearing cilia which are short and fine; styles confined to the right-hand half of the ventral surface, and consisting of six frontal, three ventral and five anal ones, the extremities of each of the last finely fimbriated; caudal setæ four, the two on the right-hand side of the median line much branched; dorsal surface convex, without longitudinal furrows, minutely roughened and often ornamented by longitudinal rows of equidistant elevations formed of minute prominences arranged in stellate clusters; contractile vesicle in the posterior body-half near the right-hand border; nucleus band-like, curved, very long, extending around nearly the entire periphery, its extremities separated by a short interval near the right-hand body-margin; anal aperture in close proximity to the contractile vesicle. Length of carapace  $\frac{1}{16}$  inch. Habitat.—Pond water, near the bottom.

The rounded angle projecting from the centre of the left lateral border is not always so conspicuous as in the figure, (Fig. 8,) while it is occasion-

ally even more marked. The finely-fringed extremities of the anal styles are diagnostic, not having been observed in any other species of the genus, and suggested the specific name, feather-footed. The ornamentation of the dorsal surface, shown in detail in Fig. 9, is not constantly so regular as there delineated nor so plainly developed. At times the stellate clusters are so prominent that they obtrude themselves upon the observer's attention; at others they consist of scattered dots or minute, elongated elevations collected into irregular and imperfectly star-like patterns. The nucleus is remarkable for its great length. Its extremities are usually separated by a considerable space; occasionally, however, they are apparently in contact or even overlapping.

Conjugation takes place by the union of the left-hand half of the ventral surfaces, and reproduction, in which there are some points of unusual interest, by transverse fission. The first noticeable change preceding the latter act is the appearance of a series of cilia almost parallel with the left-hand border of the peristome. From the comparatively vacant space over which the ventral styles are scattered, the zooid soon gradually extrudes fourteen new styles, a second contractile vesicle appears and the animalcule presents the interesting aspect of an infusorian with a double series of adoral cilia, two pulsating vacuoles, four caudal setæ and twenty-eight ambulatory styles. The body quite rapidly elongates until about twice the length of the ordinary animalcule, and separates across the middle, dividing up the twenty-eight styles so that the anterior moiety preserves the old frontal and ventral ones, and takes five of the new for its anal ones, extruding four fresh caudal setæ. The posterior portion therefore has the newly extruded frontal and ventral styles, the old anal ones and the old caudal setæ. But before final separation the posterior moiety

extrudes four additional caudal setæ, and thus has twice as many as the normal complement. Some of the books state that at a certain stage in the tadpole's development the tail falls off, and I was prepared to accept, in advance of ocular demonstration, this incorrect teaching in connection with the four old setæ, although nature never seems wasteful. But the treatment of the tail by the tadpole is the treatment of these setæ by the infusorian. They are absorbed; not all at the same time, nor yet all in regular sequence, but when the newly extruded seta is completely formed then the old one is gradually merged into the zooid's body; the more profusely fimbriated, being more complicated, are the last to appear and the last to be absorbed.

*Cyclidium litomesum*, sp. nov.—(Greek, *litos*, smooth; *meson*, the middle.)

Body ovate, somewhat compressed, longitudinally striate, the length about two and one-half times the width, the extremities subequally rounded; dorsal surface convex, with a slight sub-central concavity, the ventral one flattened, somewhat concave; oral aperture situated slightly behind the centre of the ventral surface; the lateral and dorsal cuticular surfaces of the central region of the body entirely naked; setæ of the anterior region fine, numerous, their length equalling or exceeding the width of the body, the setæ posteriorly situated diverse in length, several of them exceeding the length of the entire zooid; contractile vesicle postero-terminal; oral velum or hood large, its width equaling that of the body. Length of the body  $\frac{1}{800}$  inch. Habitat.—Pond water with *Ceratophyllum*.

This form is distinguished from all other members of the genus by the extreme length of the posterior setæ, and by the unclothed central region of the zooid. It is shown in Fig. 10, magnified 420 diameters. The anterior setæ have the rigid aspect of those of *Pleuronema*, rather than the

usual appearance of those of the other members of this generic group.

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### Note on the Structure of the Scales of Butterflies.\*

BY DR. ROYSTON PIGOTT, M. A.,  
F. R. S., F. R. A. S.

'The gilded summer flies are numerous as leaves in Vallombrosa.' No recess of the forest so obscure but there the winged messengers are seen to sport and play. Each summer sunbeam lights up the gorgeous hues of those bright creatures which even the sombre Dante has named 'angelical,' adorned with hues

'Which make the rose's blush of beauty pale  
And dim the rich geranium's scarlet blaze.'

Nor is the internal structure of these angelical creatures' wings less endowed with a rare beauty of symmetry and splendor. The resources of a divine art of construction have resulted in strength and lightness, grace in action, elegance in repose, brilliance in effect, delicacy of combination, yet tubes, membranes, and, above all, what I have ventured to term organic molecules, evolve these mysterious wonders, under the all-pervading laws of undulatory vibration among the almost inconceivably small wavelets of light. You all may have noticed in your childish sport the exceeding loveliness of the sun-gilded soap bubble. At the thinnest spot of the film—the highest just before bursting—a black spot arises; here the thickness of the material is just about 1-1,000,000th of an inch. No light is reflected there. A series of ringed colors show themselves in many orders. The instrument before you, which I constructed for the Royal Society, exhibits all these beautiful color phenomena. A film of air or oil will each do equally well. This thickness is regulated by a screw and by wheel work; the thickness can be measured to a much less size than the 1-100,000th of an inch. It

\*Read before the Natural History Society, Eastbourne. Reprint-d from the *Eng. Mechanic*.



is so sensitive that blowing upon the instrument sometimes changes the colors. It shows the bubble black spot, and another person with me has counted thirty-four changes of color between the millionth and the thirty-thousandth part of an inch in thickness of the film. This study is most fascinating. But turning to the magnificent coloring of the butterflies' wings—let us see if we can get any inkling of the cause of these rich variations in colors. Take the azure blue, the flitting denizen of our breezy downs; viewed against a strong light it is brown. Seen directly by the eye, without a glass or magnifier, it throws out a heavenly blue; but as we increase the power of our apparatus this color vanishes. The varied prismatic flashings of mother-of-pearl—finely engraved steel—are owing to fine lines. But in the same wing we have these same lines most equally arranged, and yet different portions show every possible variation of color. It is not then in the lines. Where is it then? In the arrangement and size of these organic molecules and of the striations. For full thirty years of my life have I been straining optical 'powers' to get a glimpse of minute structure unseen before. Here is one 'power' or objective I have had more than that time, made 40 years ago by Messrs. Powell and Lealand. This showed me minute bodies invisible generally in more modern glasses. I must detain you a few moments on the size of these molecules. Last year, through the kindness of Mr. Adams, of Meads, who placed at my disposal a number of unusual objects, I discovered the molecules of an elephant's hair and those of the hair of the English bats were almost precisely the same size. But in butterfly scales they vary exceedingly from the 1-40,000th to the 1-120,000th of an inch in breadth. In some of the azure blues the structure is exceedingly minute. Now the wavelets of light are the smallest for blue and the largest for red. Here is a

hint from Nature. With a power of 500 the cross bars can only just be described by daylight with super-excellent optical powers. Twenty-one years ago, with the finest glass these opticians could make for me, I thought it a magnificent feat to resolve these scales into beaded ribs merely. The makers improved the glass after my complaining of a yellow fog, the detection of which greatly astonished them; it will now just show the beaded bars. The scales are mixed with fine delicate yellow ones; these may be young scales. The rich brown of these scales by transmitted light—I mean viewed transparently—is a striking contrast to the rich cerulean blue seen in ordinary reflected light. One from the West Indies exhibits very small molecules indeed. Catching sight of these organic molecules, I repaired to our own willing and distinguished member, Mr. Muller; he gladly undertook the dissection of a number of scales by means of chemical reagents. He succeeded in dissolving the material which appeared to cement the structures together. We were rewarded, under the best powers I could muster, with the sight of prominent villi in the scales of several of these insects. The peacock butterfly showed its ribs were formed of innumerable minute bodies. The *Amathusia* showed also without chemical dissection its whole surface covered over with an infinite crop of bodies resembling a thickly sowed bed of mushrooms. The most reliable power of 2,000 diameters distinctly exhibits the stem, base, and head of the *Villum*. The extraordinary difficulty of discerning these bodies has doubtless long prevented microscopists from discovering them. Unfortunately the use of these very high powers is almost impossible in a mixed company. No one is allowed to move during delicate astronomical work, and you can no more see and discuss the forms of objects the one hundred thousandth of an inch in a vibrating room full of company than

you can read the smallest print in the Great Northern express train. But objects of the millionth of an inch in diameter can be made distinctly visible under special precautions and arrangements. Returning then to the general structure of butterfly scales, the pedicel or quill is hollow, and this hollowness, in the shape of canals, radiates more or less from the quill, more or less filled with what I may call butterfly oil or sap, which appears to perform the same office as the sap of plants under the control of natural forces; here developing a membrane, there a tube, and many a molecule perhaps helping to keep these tubes expanded. But often through the inadvertent pressure of the nose of the microscope on the delicate glass cover (which for the highest powers is less than half a hundredth of an inch thick) these delicate forms are displaced, spread out, crushed, or distorted; the contents escape, the membranous envelope being ruptured, and organic molecules are seen either in heaps or isolated. But marvellous to relate, some of these structures, thus deformed, have been seen the next day to have resumed their former shape. Within these structures the sap or native oil has been seen flowing up and down in a manner at once demonstrating the oil is contained in a system of veins or tubules, and within these, occasionally, organic molecules are formed, as shown in the drawings. This movement was caused by the fine adjustment of the microscope inducing more or less delicate pressure on the glass-protecting cover. On rare occasions scales may be caught entangled edgewise between the glass slide and this cover, and then the projection of the little villi can sometimes be beautifully seen, at one time sideways, at another end on, towards the eye of the observer. On one occasion I have seen the ribs on one side in this way corrugated, and on the other side next the insect's body smooth. Besides these general scales, others

appear inflated like small balloons, and are called battledore scales. The two adjacent, or upper and lower, membranes appear supported and kept from collapsing by a series of little pillars supporting them, attached to opposite ribs; whilst with my best glasses I have seen the whole surface thickly strewn with minute organic molecules. By the courtesy of Mr. Curties, manager to Mr. Baker, of Holborn, a great number of mounted specimens were obtained for my use. With a power of 3,000 diameters many of the specimens showed molecules irregularly distributed upon the membrane near the quill—as bright and translucent as dew-drops. Are many of these rainbow splendors caused by similar optical means? Myriads of falling raindrops catch the sunbeams, and after internal reflections (one or more) emerge with brilliant prismatic tints—caused by the decomposition of the light by refraction after internal reflection. Myriads of transparent molecules here also reflect light with various degrees of brilliance and color. The colors of these creatures are apparently due to a similar cause—reflection and decomposition of solar light. ‘Marvelous are Thy works; in wisdom hast Thou made them all.’ Very much has been written whether the delicate membrane of these beautiful scales is complex—I mean double quadruple or single. The question seems settled by the following facts. The sap flows between the tubes; scales are apparently a kind of flattened hairs, most of which are more or less hollow and similarly endowed with molecules. Squeezed accidentally, an oily sap escapes. But another fact of an optical nature is still more decisive. Under the very finest instruments extant the former hazy margin of the most delicate scales becomes brilliantly clear, sharp, and black—a thin black line about the hundred thousandth part of an inch thick. This sharp black line is as precious an indication of instrumental perfection as



the black divisio is in Saturn's rings to the astronomer. This black line is thus caused. Light is stopped at the edge where the transparent membrane is folded back. As an illustration—if gold leaf, which is transparent and about 1-200,000th of an inch thick, be doubled back, at the line of doubling or folding a black line appears in the translucent blue of the leaf. I have seen the same thing on folding carefully a piece of gold-beater's skin. No light shows through at the line of folding. All transparent tubes visible in the best possible instruments show also too black for borders. In the same way each of the ribs of these scales when unclouded with beading or molecules exhibit these beautifully well-defined black lines. Any one who possesses an instrument which clearly and sharply displays these black margins in minute delicate scales may be congratulated on the superlative excellence of his instrument.

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## EDITORIAL.

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**Publisher's Notices.**—All communications, remittances, exchanges, etc., should be addressed to the Editor, P. O. Box 630, Washington, D. C.

Remittances should be made by postal notes, money orders, or by money sent in registered letters. Drafts should be made payable in Washington, New York, Boston, or Philadelphia.

Subscription-price before April 1st, \$1 per year, in advance. All subscriptions begin with the January number. After April 1st the subscription-price will be \$1.50.

The regular receipt of the JOURNAL, which is issued on the 15th of each month, will be an acknowledgment of payment.

The first volume, 1880, is entirely out of print. The succeeding volumes will be sent by the publisher for the prices given below, which are net.

Vol. II (1881) complete, \$1.50.

Vol. III (1882) complete, \$2.00.

Vol. IV (1883) complete, \$1.50.

Vol. V (1884) complete, \$1.50.

Vol. V (1884), Nos. 2-12, \$1.00.

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—The subscription-price for the sixth volume, which begins next month, if paid now, or before April 1st, 1885, is \$1.00. If paid after that date it will be \$1.50.

It is a great convenience to the publisher to receive subscriptions early in the year, as it enables the new subscription-list to be arranged,

and confines most of the clerical work to the first month or two.

The January number will not be sent as a sample copy to present subscribers.

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END OF VOLUME V.—Although five years is but a short span in an average lifetime, they may witness many changes, and bring forth abundant fruit in scientific discovery and progress. To us they have been rapid years. Measured by the results of individual industry, they may seem for the most part barren—yet here and there one may find the stepping-stones which bear evidence of progress, and an upward tendency.

While a retrospective glance over the field of microscopy would be of interest, and while it would show with what rapid strides new ideas have made their way into the minds of students and observers, and have become, in fact, working hypotheses with many, we are unable now to give sufficient thought to so great a subject. We would only recall to mind the fact, that when this JOURNAL was started the subject of vision with the microscope, as at present understood, had scarcely been outlined in this country. The researches of Prof. Abbe had, indeed, been alluded to here and there; but no connected or intelligible account of them had been published. The true functions of angular aperture were not known, and homogeneous-immersion objectives were scarcely heard of. Not that the subject was not at that time understood, for Prof. Abbe's elaborate paper had been published several years before, and a translation had also appeared in England, which, however, was but little known.

There was needed a journal which would keep its readers informed not only concerning the work that was in progress in this country, but also in England, Germany, and France. At an opportune moment this JOURNAL was established and received cordial support. It has endeavored to fill a

certain place, and to be a publication which would be valued especially by those who use the microscope to unfold the beauties of the unseen world for pleasure, but also by those whose labors in science require a knowledge of the methods of microscopical research, and of the improvements in microscopes and accessory apparatus.

The careful reader of its columns from month to month will have a very creditable knowledge of what is going on in the world, in general microscopical work, such as is not to be obtained from any other publication in the country.

As a result, it is now the most widely read, and by far the largest, microscopical publication in the country. With such a record and the many flattering promises for the future, the Editor is encouraged to spare no efforts to increase its value and influence.

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POSTAL CLUB BOXES.—Box 4 came to hand November 1st. It contains six slides by Mr. J. Kruttschnitt, illustrating his views of the process of fertilization of the ovule in plants. These views have already been set forth in these columns,\* and need not be explained here. We would remark, however, that the botanists seem to be quite content to ridicule or ignore Mr. Kruttschnitt's work, without giving it the slightest consideration. It is a pity this should be so; for, although much work has been done by competent observers in this field, it is by no means impossible that there is still something to be discovered by others. We are aware that Mr. Kruttschnitt has been unable to get much information from well-known botanists to whom he has applied. If he has been working by erroneous methods he has nevertheless been working earnestly and persistently; and it is scarcely creditable to the scientific spirit of our botanists that they have refused advice or as-

sistance, or even courteous criticism. Comparatively few of the botanists ever use a compound microscope, and of those who do not many are aware of the amount of labor involved in a thorough microscopical investigation by means of thin sections. Perhaps, therefore, it is not strange that they do not appreciate the merit due to the observer who, after working quietly alone, ventures to bring forward the results of microscopical examination which do not correspond with accepted teachings. Nevertheless, the work has its value, whether it finally leads to other conclusions or not.

It would seem that it is time Mr. Kruttschnitt's conclusions should be submitted to critical and experimental examination. They have been before the world long enough, and have met with only contempt from persons who should know that errors are not to be corrected by ignoring them. Yet not one has ventured to treat the subject in a scientific spirit, and as the specimens have passed through circuit after circuit of the club, not a person has yet pointed out a source of error. Mr. E. A. Rau, indeed, has confirmed some of the observations. He says: 'In fact, the pollen-tubes are short, and appear to be invariably distant from the ovary. This part of the process of fertilization appears to be a myth, as usually copied in the various works on botany.' Another note by J. T. Brownell is appended, who concludes that the theory is 'not proven'; to which Mr. Kruttschnitt might well reply that it is not to be disproven without practical work and observation.

If the process of fertilization in the flowering plants is carried out by the growth of the pollen-tube and its extension, sometimes for a long distance, through the tissues of the style to reach the ovary and finally the individual ovules, it would be interesting to trace the different stages in the evolution of this unique process. Where else do we find anything of



the kind? Has the evolution ever been traced, or are the intermediate stages entirely lost? These and similar questions present themselves to our mind; and unless some of our botanists will come forward and at least indicate in a general way the nature of the evidence which is so strong that present researches on this subject are superfluous, there will be some persons who will be led out of the beaten path by Mr. Kruttschnitt's observations.

It is well known that competent observers claim to have traced the pollen tubes through the styles of certain plants. This, however, does not prove that this process of fertilization is universal.

Box E<sup>2</sup> came to hand Nov. 3d. It contains some very good specimens for study.

1. Scales of *Lepidocyrtus curvicolis*. Louis H. Noe. This slide of the test-podura scale, mounted by Mr. Walmsley, is a very good one. Unlike most test-objects, the larger and more distinctly marked scales are regarded as most desirable for testing objectives, and on this slide there are a number of them. (Conf. Vol. IV, p. 101.)

2. Larval Oysters. Rev. S. Lockwood. This is a specimen mounted in balsam. The shells are much better seen as opaque, dry-mounted objects.

3. Lingual Ribbon of *Natica*. E. A. Apgar. J. D. King thinks it is not correctly named, and suggests that it may be the linal ribbon of young *Fulgus carica*, with central teeth longer and narrower than usual in the specimens found on the coast of New England.

4. Small intestine of Rabbit. R. H. Chase. Injected.

5. Spiracle of Blow-fly. T. D. Hodges.

6. *Asterosporium Hoffmani*, Star Fungus. E. A. Rau. The stellate spores are quite remarkable and abundant. This specimen is described in the letter.

Box Cj. arrived Nov. 19th with two of Cole's preparations, viz., a transverse section of stem of maple, and a similar section of petiole of *Limnanthemum*.

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**MATERIAL FOR DISTRIBUTION.**—After considerable delay we are at last able to offer a few specimens of material for mounting for distribution among those subscribers who may desire them.

It will afford us pleasure to share this material with those who will prepare it for study; but it may well be understood that the preparation of two or three hundred or more packages of various kinds of material involves considerable expenditure of time, and we would therefore request all who desire to receive material which is liable to injury in an envelope, such as polycystina or foraminifera, to send us small boxes of wood or pasteboard, inclosing a stamped tag, addressed for return. We can then put in the material desired without undue expenditure of time.

Those who wish diatomaceous material can enclose a stamped and addressed envelope, made of tough paper, so that the hard lumps will not break through. We cannot undertake to provide the mailing packages and do all the addressing, but must request those who desire material to assist in its preparation to the extent mentioned above.

The following named specimens are now ready for distribution on the terms mentioned below:

Diatomaceous material from Toome Bridge, Ireland, Port Hope, Can., Monterey, Cal., San Gregorio, Cal., Richmond, Va., Virginia City, Nev.

Foraminiferal material from Canada, Gravesend chalk, England.

In a few cases we can send some Barbadoes earth, containing Polycystina, some spines of echini, suitable for sections, and possibly some other specimens.

While we wish to accommodate every one in the distribution of spe-

cimens, we cannot promise to send the particular ones asked for, as the supply of some of them is small. Requests will receive attention in the order they are received.

The following regulations will govern the distribution of specimens, viz :

1. Specimens will only be sent to those who send envelopes or boxes, stamped and addressed for return, as mentioned above.

2. Not more than two specimens will be sent to a single applicant.

3. Loose postage stamps are not desired. We cannot undertake to return stamps.

—o—

CONCERNING MICROSCOPES.—A somewhat amusing, as well as characteristic, article entitled 'Workers and their Instruments' appeared in the October number of *Science Record*. The writer, who is evidently the editor, gave a list of thirty-one persons 'who by their researches with the microscope are actually increasing the sum of human knowledge, and none who are microscopists in the narrow sense of the word,' stating in each case the kind of stand used by the person named. From this list it is found that thirteen use Zeiss, ten Hartnack, five Zentmayer, three Tolles, two Wales, and the others Beck, Gundlach and Seybert stands. The obvious purpose of the article was to prove the superiority of foreign microscopes over those of American manufacture. It is true, the author admits, that 'there are several makers who turn out very creditable instruments' in the United States; and we are surely much pleased to read even that concession from such a source. It must, indeed, be gratifying to some of our best makers to be thus encouraged and patronized.

Unfortunately for our author, his article proves nothing. In the first place, the list of names is too small to be of much consequence in an argument of this kind; moreover, it is far from comprehensive. Evidently

it is made up only of persons known either personally or by reputation to the writer of the article, and, therefore, it is scarcely representative. It is true, all the gentlemen named are eminent for their scientific work; yet scarcely any of them have been engaged in microscopical work requiring special skill as microscopists. Why, then, need they consider for a moment what is the most perfect stand, when the simplest and most convenient German microscope serves their purpose perfectly well?

On the other hand, we might compile a similar list, embracing only persons who 'are actually increasing the sum of human knowledge,' etc., and more especially by researches strictly microscopical—that is, who require the highest technical skill in their work—with quite different results. Strange as it may seem to a writer who is not acquainted with the whole comprehensive field of microscopical work, there really are other persons in the country who are 'actually increasing the sum of human knowledge' by their microscopical observations. We trust they will not feel slighted at being left out in the cold, for the writer of the article either did not know them, or was not aware of the value of their work—which is his misfortune.

Although we have not tabulated the results of our own limited observations, we are still under the impression that American microscopes are quite generally used and recommended by American scientific observers. However, it is a useless pastime to argue over this matter. In one respect the German stands have the advantage over our own, but the writer does not intimate that any person's choice could be influenced thereby. It is this: Foreign microscopes can be imported free of duty, by institutions and professional men, cheaper than equally good American ones can be bought. But the foreign instruments are no better—indeed in some respects not so good—as those of a



similar style made here. Our readers well know that we strongly advocate the use of the low, German microscopes for general work. We have likewise urged their manufacture here, to meet a reasonable demand. Yet, when a writer endeavors to prove, by such inadequate methods, that foreign microscopes are superior to our own, the arguments deserve at least some refutation.

Let us enquire what constitutes the superiority of a microscope. If it is to be used for the ordinary purposes of a naturalist, surely the simplest imaginable stand will do all that is required. It will be found, as a rule, that the persons who affect to despise the fine microscopes of the present day, although they may be good observers in their particular fields, have no knowledge of the more delicate methods of microscopical investigation. Many of them have never used a beam of light out of the optic axis, and as for manipulation to discover fine details, why, they could not show the dots on the *Pleurosigma angulatum*.

A very different case is presented when we consider the requirements of those who find it necessary to use the best objectives, and to test their highest capabilities in their work. There are now required larger and more elaborate stands. We need not explain why, as every experienced microscopist knows very well. It appears, also, that even on the continent there is a steadily increasing demand for more elaborate and larger stands than were heretofore much used, and the large stand of Zeiss is no less elaborate, while considerably heavier, than stands made in this country that will do the same work. To condemn such stands is to virtually deny the value of the best objectives. It is possible that if the writer of the paragraphs under notice had carefully read the article published in the October number, which was read by the present writer before Section G of the A. A. A. S., he would have learned just what value

these objectives possess, and also why it is not possible to get the full benefit of them on the common German stands. He might also have learned that they are constructed for special purposes, and that they actually do fulfil those purposes; that their value in scientific investigation is capable of accurate mathematical expression, and is not merely a matter of personal opinion.

—o—

MICROSCOPICAL SOCIETIES.—Last month we referred at some length to this subject, indicating some of the causes which tend to interfere with the efficiency and prosperity of societies of this kind. It may be assumed that all such organizations that are formed, in the smaller towns at least, will be composed in great part of persons who do not make any pretensions as professional scientific men. If there should be two or three professional observers among them it will be all that can be expected. In other words, such societies are sure to be formed of amateurs, most of whom use the microscope for instruction or entertainment, without attempting original research. It would be well, indeed, if some of these could be led to take up some branch of study systematically. The attempt has often been made to induce members to do this by introducing resolutions appointing certain ones to investigate and report upon specified subjects. This scheme is sure to fail of the desired results. It is impossible to induce scientific work in this way. No purely artificial incentive will do it. How, then, can it be brought about?

There is only one way to accomplish this result. It is by no means the sole object of microscopical societies, and, while a very important one, it should not be regarded as the primary one. It will be an incidental result of meetings that are conducted in a manner to be most interesting to all the members. It cannot be brought about by meetings ostensibly conducted to attain that end. The offi-

cers should, therefore, consider how the members generally can be best interested and instructed, and in doing this they may reasonably hope that some of them will be led to investigate special subjects, and become recognized authorities in the fields of work chosen.

If the meetings are to be interesting and instructive somebody must work to make them so. It involves no little labor on the part of the few who undertake to conduct a successful society. Still, the time thus spent is not without profit both to the individual and to the members. One need not be thoroughly informed upon microscopical subjects to be an efficient leader. It requires energy, interest, and a willingness to work, more than anything else. Let those who are willing to give their time and work for the benefit of others who do little else than attend the meetings to learn what they can, study up and present different subjects of interest in papers, or more informally, and continue in this way. After awhile they will find others coming forward, and the society will grow.

If the meetings can be made instructive members will be sure to attend. If they are dull, and if nothing is done to make the time pass profitably as well as pleasantly, so that members will feel that it is worth while to attend, the society might as well disband.

—o—  
THE CHOLERA MICROBE.—Dr. Van Ermengem, who has been studying the microbe discovered by Dr. Koch which is associated with Asiatic cholera, recently presented a valuable contribution before the Microscopical Society of Belgium, which is published in the *Bulletin*. His researches confirm the observations of Dr. Koch, and controvert those of Messrs. Finckler and Prior, who claimed to have discovered a microbe quite similar to Koch's comma-bacillus in the dejecta of patients suffering from cholera *nostras*.

The paper of Dr. Van Ermengem

is a long one, and we can only briefly allude to the results of his investigations as follows:—

He finds that an organism resembling the comma-bacillus discovered by Koch exists in the intestines of persons attacked by cholera, its incurved form, its grouping-like S and in chains, produced by the juxtaposition of its articles, and at times its configuration in slightly undulating filaments, furnish characters which enable it to be easily recognized. The microscopic examination of dejections suffices to establish the diagnosis of Asiatic cholera when preparations are obtained in which the diverse forms of commas predominate.

The study of the morphological characters of the commas at their various periods of development, cultivated in different media, principally in chicken bouillon and serum, indicate that they should be placed in the genus *Spirillum*. No period of sporulation has been observed. The most favorable temperature for their development is 25°–37° C.

Inoculation experiments with products of culture have given very encouraging results on several species of animals.

The cultures of organisms to which Finckler and Prior attributed the production of cholera *nostras* were impure.

Koch's method of culture on a slide is highly recommended to obtain the comma-bacillus pure. It is conducted as follows: After having charged a needle with the organisms of a previous culture, the needle is carefully washed in 100 c. c. of sterilized water. The organisms thus introduced are disseminated through the water, and one drop is then taken in a pipette and added to 2 c. c. of a 10 per cent. solution of gelatin, liquified at 25° C. This gelatin is then cooled on two slips of glass placed horizontal, and protected under bell-glasses. The growths start from centres, and the different organisms are thus perfectly separated.



## NOTES.

—All subscriptions for the year 1884 have now expired, and renewals should be made early to ensure prompt receipt of the January number of 1885. The most successful year this JOURNAL has yet seen is now drawing to a close, with flattering assurances from many quarters that it has a great value to a large number of readers. Many valuable articles for next year are already on hand, and no efforts will be spared to make its future equal to the promise of the past.

—We have received from Mr. G. S. Woolman some preparations of diatoms by Mr. W. C. Walker, which he proposes to offer for sale at 75 cents each. The diatoms are well cleaned, carefully selected, and arranged in groups within ornamental circles. The arranging and mounting is neatly done, and the diatoms are in most cases named on the label. These slides are unique from the ornamental mounting, which must involve considerable expenditure of time. Mr. Woolman says he has only a limited supply on hand.

—Messrs. H. R. Spencer & Co. have again assumed control of the business of selling their objectives, Dr. H. H. Chase no longer acting as their agent. Orders and correspondence should hereafter be sent directly to them, where they will continue to manufacture the fine lenses for which they have attained a high reputation.

—A vial of water obtained by melting ice was sent to Prof. Leidy for examination, as it contained some worms in the sediment which had previously been noticed in water from a cooler. Prof. Leidy found a number of worms, belonging to the genus *Lumbriculus*, immature anguilulas, and *Rotefer vulgaris*, all living. These observations indicate a source of contamination of water which is not generally suspected, although other observers have before alluded to the organisms found in water from melted ice. The remarkable circumstance in this connection is that the specimens found by Prof. Leidy were alive.

—An article, illustrated by three plates, on the 'Life-history of Stentor Cœruleus, or Blue Stentor,' has been published by the Central Ohio Scientific Association, in the Proceedings. The author is Prof. G. W. Worcester, who has labored under the disadvantage of not having the litera-

ture of the subject at command. According to his own statement, he was thus 'left free to investigate without being influenced by the theories of other observers.' He observed the fusion together of individuals, the formation of a globular mass, the segregation of the protoplasm into spherical masses, and the production of embryos within the body. The article is an interesting one, as showing the many changes which the stentor undergoes.

—*The Microscopical News*, ably edited for four years by George E. Davis, F. R. M. S., closes its career with the December number. We regret to lose it from among our exchanges, as it has contained many articles of interest, and it has been conducted in a scientific spirit from the beginning. The editor has been disappointed in not receiving the encouragement his efforts have deserved, and he has therefore deemed it best to abandon the field.

—Having occasion recently to purchase a cabinet for slides which would allow a large number of preparations to be classified and compactly stowed away, we were not long in deciding to adopt the Pillsbury cabinet, which we have occasionally recommended to others. It is a very cheap cabinet, which favors its extensive use, but it is also a good one. Unfortunately it is not much known, as the makers do not adopt the best method of bringing it to the notice of microscopists; and the low price at which it is sold makes it scarcely suitable for sale by the general trade. Nevertheless, any of the dealers in microscopes would, no doubt, gladly furnish them to their customers, if requested to do so.

—The list of wood sections prepared for the microscope by the Rev. J. L. Zabriskie includes a large number of species. Transverse, radial and tangential sections of each kind are mounted under one cover, for 60 cents per slide. A set of these preparations would certainly be interesting and instructive to a botanist.

—It is to be regretted that there is no creditable serial publication in this country devoted to general science of a popular character. The reader who desires such a periodical is obliged to order it from England. There are two monthlies now published in London, either of which we can heartily recommend. *Science Gossip* is one of them, now published by Chatto & Windus, and greatly improved during the past year. The articles on 'Graphic

Microscopy' by E. T. D., which have been published this year, with colored lithographs, are very interesting. This paper is devoted mainly to general natural history. *The Illustrated Science Monthly*, published by David Bogue, completes its second volume this month. This is devoted to general science, and we regard it as the best publication of the kind in existence. We should have such a paper in this country.

## CORRESPONDENCE.

### Staining and Mounting Casts, etc.

TO THE EDITOR:—Two years ago I put up in glycerin many pathological specimens derived from urine—cases of acute and chronic nephritis, cirrhosis, etc. The casts especially and some of the other elements have quite faded out. I have purchased slides stained of acute nephritis, which seem permanent, and show the casts beautifully.

If in your articles 'Microscopical Technic' you can give us the process of staining and mounting in this manner, I think it may interest others as well as myself.

L. A. BALDWIN.

[It is not always a simple matter to preserve specimens found in urinary deposits, although the more common deposits such as uric acid, urates, phosphates in their various forms, can be put up so as to remain perfect for years. We have a few such deposits that have been preserved in small vials for eight years or more, and they were in good condition a few months ago. The secret of preserving crystals is to put them either into a fluid which will not act upon them, or into a saturated solution of the compound. We do not at present remember how the preparations above mentioned were made, but we have occasionally mounted deposits in the mother liquor with the addition of a small quantity of carbolic acid, with satisfactory results.]

As for staining the tube-casts we must ask some reader who has had experience in this work to give the necessary instructions. We have not found any difficulty in preserving the casts without staining, but it is certainly an advantage to have them colored. Anilin colors are scarcely fast enough for the purpose. Doubtless a longwood staining fluid would be useful, or carmine.

We have seen stained casts mounted in balsam, but cannot recommend the process. Even glycerin is not a desirable

medium for the purpose, except for very large and coarse specimens. Water with a little carbolic acid in it preserves them well and shows them as they are found in practice.—ED.]

## NOTICES OF BOOKS.

*The Agricultural Grasses of the United States.* By George E. Vasey, Botanist of the Department of Agriculture. Also the chemical composition of American grasses. By Clifford Richardson, assistant chemist. Washington: Government Printing Office. 1884. (Pp. 144 with 120 plates.)

This is one of the many valuable scientific publications of the Department of Agriculture. The name of Dr. Vasey is sufficient guarantee of the accuracy of the descriptions and figures. Every botanist should possess a copy.

*Preliminary List of the Parasitic Fungi of Wisconsin.* By William Trelease. From the Transactions of the Wisconsin Academy of Sciences, Arts, and Letters. Volume VI, 1881-'84. Madison, Wis. (Pamphlet, pp. 40.)

The fungi in this list, of which there are about 270 species on approximately the same number of hosts, include only those which were examined by Prof. Trelease; most of them from the vicinity of Madison. The list will probably be nearly doubled by a few years' collecting.

## Exchanges.

[Exchanges are inserted in this column without charge. They will be strictly limited to mounted objects, and material for mounting.]

Unmounted material and labels for slides in exchange for good slides.

EUGENE PINCKNEY,  
Dixon, Ill.

Fossil Diatomaceous Earth, (a new find), very interesting forms for other material.

J. WALKER,  
810 Twelfth Ave., South Minneapolis, Minn.

Wm. R. Mandeville, M. D., of New Orleans, La., 483 Magazine street, has for exchange or sale a number of first-class mounts of pathological specimens, including yellow fever and leprosy; also a large number of miscellaneous objects.

Material for mounting of all kinds wanted in exchange for other first-class unmounted objects in great variety.

M. A. BOOTH,  
Long Meadow, Mass.

Will exchange very thinly cut and well-stained histological and pathological slides for other histological and pathological slides. Will also exchange a limited number of histological for other slides of various kinds.

H. L. WHITNEY, M. D.,  
German Hospital, Girard ave. and 21st st.,  
Philadelphia, Pa.



THE AMERICAN

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MICROSCOPICAL JOURNAL





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EDITOR

ROMYN HITCHCOCK, F. R. M. S.

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VOLUME VI

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WASHINGTON  
GIBSON BROS., PRINTERS AND BOOKBINDERS  
MDCCCLXXXV





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# THE AMERICAN MONTHLY MICROSCOPICAL JOURNAL.

VOL. VI.

WASHINGTON, D. C., JANUARY, 1885.

No. 1.

## Culture-tubes for Micro-Organisms.

In a previous number of the JOURNAL, (Vol. V, p. 183,) the methods of cultivating micro-organisms, as conducted by Dr. G. M. Sternberg and Dr. D. E. Salmon, were described. The relative merits of gelatinous and fluid media, and the special adaptability of each for specific purposes were concisely stated in the article by Mr. T. Smith, Vol. V, p. 185. We have now to present illustrations of the two tubes used by the observers named. Having seen the tubes in practical use in both laboratories, we can only testify to the efficiency of either form, and there is no apparent reason why one should lead to any better results than the other. It is purely a matter of individual preference which form shall be used, governed no doubt in part by the nature of the work to be done, and the conditions under which it is conducted.

In the laboratory of the Department of Agriculture both Dr. Salmon and his assistant, Dr. Smith, who have been using the tube devised by the former for a long time, regard it as the best and most convenient for their work. Dr. Sternberg, on the other hand, prefers his own for convenience as well as for economy.

In the article by Dr. Sternberg, referred to above, he has stated the advantages of his tube, which is shown in Fig. 1. Without repeating the statements there made, we can only say that on the score of economy it is to be most highly recommended. The bulbs are easily blown by any person with very little practice, so that one has only to purchase the

glass tubing, which any druggist can supply.

As Dr. Salmon has not yet had the opportunity to state the advantages of his tube, which is represented in Fig. 2, we take the liberty of quoting from a private letter received from him several months ago. He claims that it best fulfills the following requirements:—

‘1. Cultivation liquids are easily and safely sterilized in it, and may be safely preserved at any temperature for any length of time.

‘2. The contents are easily accessible for infecting with virus, or for examination of the cultivations at various stages of growth.

‘3. Experience shows that such infection and examination can be accomplished with scarcely any danger of contamination from atmospheric germs.

‘4. For convenience and facility of use I have seen nothing approaching it which was equally safe from contamination.

‘5. The objection of expensiveness is not one that should be considered in this class of work; but this item is largely overcome by the fact that my



FIG. 1.—Sternberg's Culture Tube.

tube can be thoroughly cleaned and safely used an indefinite number of times.

'The points about the tube which make the above-mentioned results attainable are:—

'1. The whole apparatus, including the filter, consists of glass which can be heated to a high temperature without injury.

'2. The ventilating tube allows escape of steam when heating, and thus prevents explosion from pressure; also an equalization of pressure within and without at all times, so that there is no rushing in of unsterilized air when the tube is opened.

'3. The large ground joint permits filling and thorough cleaning without trouble. The small joint is necessary to prevent exposure of a large opening, which would greatly increase chances of contamination when infecting or examining.

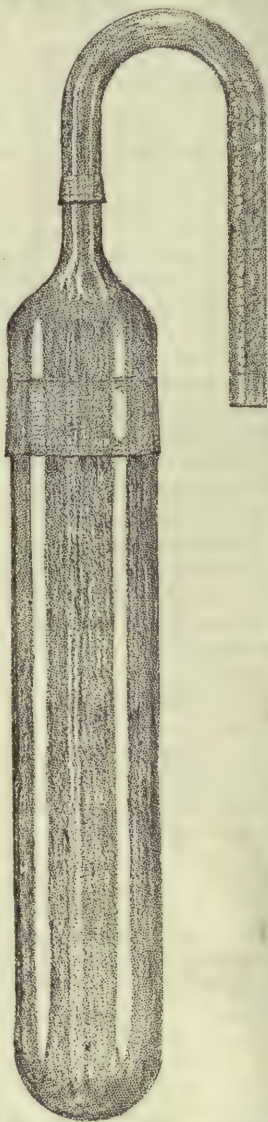


FIG. 2.—Salmon's Culture Tube.

'4. The glass-wool filter can be dried at a high temperature immediately after the liquid is sterilized. This is necessary to safety, as some moisture will condense in the filter during sterilization, and must be quickly evaporated by heating the ventilating tube in the flame of a lamp.

'Before inventing this tube I used one made on a similar principle. It consisted of a test-tube and rubber cock, through which passed a glass tube which was attached to the ventilating tube by caoutchouc tubing. The filter was then of cotton wool. They could be used safely with care, but were not quite as convenient as the new style, nor could they be heated to so high a temperature. They were sterilized by intermittent boiling, which required at least two days' time instead of an hour as at present.'

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### The Life History of *Vaucheria*.\*

BY A. H. BRECKENFELD.

Nearly a century ago, Vaucher, the celebrated Genevan botanist, described a fresh water filamentous alga, which he named *Ectosperma geminata*, with a correctness that appears truly remarkable when the imperfect means of observation at his command are taken into consideration. His pupil, De Candolle, who afterwards became so eminent a worker in the same field, when preparing his 'Flora of France,' in 1805, proposed the name of *Vaucheria* for the genus, in commemoration of the meritorious work of its first investigator. On March 12th, 1826, Unger made the first recorded observation of the formation and liberation of the terminal or non-sexual spores of this plant. Hassall, the able English botanist, made it the subject of extended study while preparing his fine work entitled 'A History of the British Fresh Water Algæ,' published in 1845. He has

\* Read before the San Francisco Microscopical Society.



given us a very graphic description of the phenomenon first observed by Unger. In 1856 Pringsheim described the true sexual propagation by oospores, with such minuteness and accuracy, that our knowledge of the plant can scarcely be said to have essentially increased since that time.

*Vaucheria* has two or three rather doubtful marine species assigned to it by Harvey, but the fresh water forms are by far the more numerous, and it is to some of these I would call your attention for a few moments this evening. The plant grows in densely interwoven tufts, these being of a vivid green color while the plant is in the actively vegetative condition, changing to a duller tint as it advances to maturity. Its habitat (with the exceptions above noted) is in fresh water—usually in ditches or slowly running streams. I have found it at pretty much all seasons of the year, in the stretch of boggy ground in the Presidio, bordering the road to Fort Point. The filaments attain a length of several inches when fully developed, and are of an average diameter of  $\frac{1}{160}$  (.004) inch. They branch but sparingly, or not at all, and are characterized by consisting of a single long tube or cell, not divided by septa, as in the case of the great majority of the filamentous algæ. These tubular filaments are composed of a nearly transparent cellulose wall, including an inner layer thickly studded with bright green granules of chlorophyll. This inner layer is ordinarily not noticeable, but

visible, as may be seen in the engraving (Fig. 3). The plant grows rapidly, and is endowed with much vitality, for it resists changes of temperature to a remarkable degree. *Vaucheria* affords a choice hunting ground to the microscopist, for its tangled masses are the home of numberless infusoria, rotifers, and the minuter crustacea, while the filaments more advanced in age are usually thickly encrusted with diatoms. Here, too, is a favorite haunt of the beautiful zoophytes, *Hydra viridis* and *H. vulgaris*, whose delicate tentacles may be seen gracefully waving in nearly every gathering.

After the plant has attained a certain stage in its growth, if it be attentively watched, a marked change will be observed near the ends of the filaments. The chlorophyll appears to assume a darker hue, and the granules become more densely crowded. This appearance increases until the extremity of the tube appears almost swollen (Fig. 3). Soon the densely congregated granules at the extreme end will be seen to separate from the endochrome of the filament, a clear space sometimes, but not always, marking the point of division. Here a septum or membrane appears, thus forming a cell whose length is about three or four times its width, and whose walls

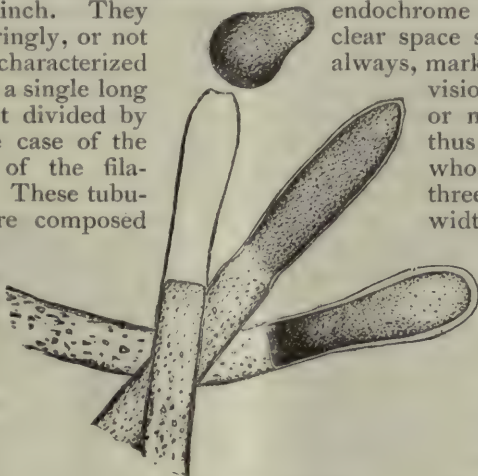


FIG. 3.—Formation of gonidia.

it retracts from the outer envelope when subjected to the action of certain re-agents, or when immersed in a fluid differing in density from water, and it then becomes distinctly

completely enclosed the dark green mass of crowded granules. These contents are now gradually forming themselves into the spore or 'gonidium' as Carpenter calls it, in distinction from the true sexual spores, which he terms 'oospores.' At the extreme end of the filament (which is obtusely conical in shape) the chlorophyll grains retract from the

old cellulose wall, leaving a very evident clear space. In a less noticeable degree, this is also the case in the other parts of the circumference of the cell, and, apparently, the granular contents have secreted a separate envelope, entirely distinct from the parent filament. The grand climax is now rapidly approaching. The contents of the cell near its base are now so densely clustered as to appear nearly black (Fig. 3), while the upper half is of a much lighter hue and the separate granules are there easily distinguished, and, if very closely watched, show an almost imperceptible motion. The old cellulose wall shows signs of great tension, its conical extremity rounding out under the slowly-increasing pressure from within. Suddenly it gives way at the apex. At the same instant, the inclosed gonidium (for it is now seen to be fully formed) acquires a rotary motion, at first slow, but gradually increasing until it has gained considerable velocity. Its upper portion is slowly twisted through the opening in the apex of the parent wall, the granular contents of the lower end flowing into the extruded portion in a manner reminding one of the flow of protoplasm in a living *Amœba*. The old cell wall seems to offer considerable resistance to the escape of the gonidium, for the latter, which displays remarkable elasticity, is pinched nearly in two while forcing its way through, assuming an hour-glass shape when about half out. The rapid rotation of the spore continues during the process of emerging, and after about a minute it has fully freed itself. (Fig. 3). It immediately assumes an ovoid form and darts off with great speed, revolving on its major axis as it does so. Its contents are nearly all massed in the posterior half, the comparatively clear portion invariably pointing in advance. When it meets an obstacle it partly flattens itself against it, then turns aside and spins off in a new direction. This erratic motion is continued for usually seven

or eight minutes. The longest duration I have ever yet observed was a little over nine and one-half minutes. Hassell records a case where it continued for nineteen minutes. The time, however, varies greatly, as in some cases the motion ceases almost as soon as the spore is liberated, while in open water, unretarded by the cover glass or other obstacles, its movements have been seen to continue for over two hours.

The motile force is imparted to the gonidium by dense rows of waving cilia, with which it is completely surrounded. Owing to their rapid vibration it is almost impossible to distinguish them while the spore is in active motion, but their effect is very plainly seen on adding colored pigment particles to the water. By subjecting the cilia to the action of iodine, their motion is arrested, they are stained brown and become very plainly visible.

After the gonidium comes gradually to a rest its cilia soon disappear, it becomes perfectly globular in shape, the inclosed granules distribute themselves evenly throughout its interior, and after a few hours it germinates by throwing out, one, two, or sometimes

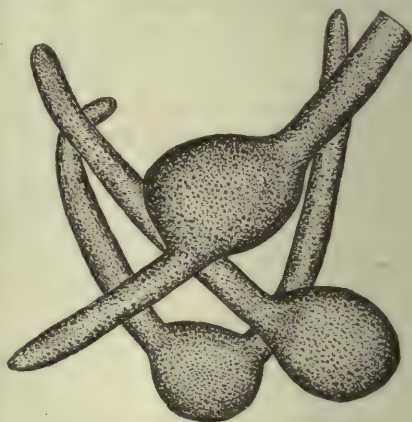


FIG. 4.—Gonidia germinating.

three tubular prolongations which become precisely like the parent filament (Fig. 4).

Eminent English authorities have



advanced the theory that the ciliated gonidium of *Vaucheria* is in reality a densely crowded aggregation of bi-ciliated zoospores, similar to those found in many other Confervoid Algæ. Although this has by no means been proven, yet I cannot help calling the attention of the members of this society to a fact which I think strongly bears out the said theory: While watching a gathering of *Vaucheria* one morning when the plant was in the gonidia-forming condition (which is usually assumed a few hours after daybreak) I observed one filament, near the end of which a septum had formed precisely as in the case of ordinary filaments about to develop a spore. But, instead of the terminal cell being filled with the usual densely crowded cluster of dark green granules constituting the rapidly forming spore, it contained hundreds of actively moving nearly transparent zoospores and nothing else. Not a single chlorophyll granule was to be seen. It is also to be noted, as a significant fact, that the cellulose wall was intact at the apex, instead of showing the opening through which in ordinary cases the gonidium escapes. It would seem to be a reasonable inference, I think, based upon the theory above stated, that in this case the newly formed gonidium, unable to escape from its prison by reason of the abnormal strength of the cell wall, became after a while resolved into its component zoospores.

I very much regret that my descriptive powers are not equal to conveying a sufficient idea of the intensely absorbing interest possessed by this wonderful process of spore formation. I shall never forget the bright sunny morning when for the first time I witnessed the entire process under the microscope and for over four hours scarcely moved my eyes from the tube. To a thoughtful observer I doubt if there is anything in the whole range of microscopy to exceed this phenomenon in point of startling interest. No wonder that its first observer pub-

lished his researches under the caption of 'The Plant at the Moment of Becoming an Animal.'

The process of spore formation just described, it will be seen, is entirely non-sexual, being simply a vegetative process, analogous to the budding of higher plants, and the fission of some of the lower plants and animals. *Vaucheria* has, however, a second and far higher mode of reproduction, viz: by means of fertilized cells, the true oospores, which lying dormant as resting spores during the winter are endowed with new life by the rejuvenating influences of spring. Their formation may be briefly described as follows: When *Vaucheria* has reached the proper stage in its life cycle, slight swellings appear here and there on the sides of the filament. Each of these slowly develops into a shape resembling a strongly curved horn.



FIG. 5.—*Vaucheria sessilis*.

This becomes the organ termed the antheridium, from its analogy in



FIG. 6.—*Vaucheria geminata*.

function to the anther of flowering plants. While this is in process of growth, peculiar oval capsules or sporangia (usually 2-5 in number)

are formed in close proximity to the antheridium. In some species both these organs are sessile on the main filament, in others they appear on a short pedicel (Figs. 5 and 6). The upper part of the antheridium becomes separated from the parent stem by a septum, and its contents are converted into ciliated motile antherozoids. The adjacent sporangia also become cut off by septa, and the investing membrane, when mature, opens at a beak-like prolongation, thus permitting the inclosed densely congregated green granules to be penetrated by the antherozoids which swarm from the antheridium at the same time. After being thus fertilized the contents of the sporangium acquire a peculiar oily appearance, of a beautiful emerald color, an exceedingly tough but transparent envelope is secreted, and thus is constituted the fully developed oospore, the beginner of a new generation of the plant. After the production of this oospore the parent filament gradually loses its vitality and slowly decays. The spore being thus liberated sinks to the bottom. Its brilliant hue has faded and changed to a reddish brown, but after a rest of about three months (according to Pringsheim, who seems to be the only one who has ever followed the process of oospore formation entirely through), the spore suddenly assumes its original vivid hue and germinates into a young *Vaucheria*.

This concludes the account of my very imperfect attempt to trace a life history of a lowly plant. Its study has been to me a source of ever increasing pleasure, and has again demonstrated how our favorite instrument reveals phenomena of most absorbing interest in directions where the unaided eye finds but little promise. In walking along the banks of the little stream, where, half concealed by more pretentious plants, our humble *Vaucheria* grows, the average passer-by, if he notices it at all, sees but a tangled tuft of dark-green 'scum.' Yet,

when this is examined under the magic tube, a crystal cylinder, closely set with sparkling emeralds, is revealed. And although so transparent, so apparently simple in structure, that it does not seem possible for even the finest details to escape our search, yet almost as we watch it, mystic changes appear. We see the bright green granules, impelled by an unseen force, separate and re-arrange themselves in new formations. Strange outgrowths from the parent filament appear. The strange power we call 'life,' doubly mysterious when manifested in an organism so simple as this, so open to our search, seems to challenge us to discover its secret, and, armed with our glittering lenses and our flashing stands of exquisite workmanship, we search intently, but in vain. And yet, *not* in vain, for we are more than recompensed by the wondrous revelations beheld, and the unalloyed pleasures enjoyed, through the study of even the unpretentious *Vaucheria*.

The very interesting phenomenon of the formation and liberation of the gonidia can readily be observed by exposing a fresh gathering of actively vegetating plants to bright daylight, in a plate of water. Usually numerous little green specks will appear on the surface about the second day. They are the freshly expelled gonidia, and by attentively watching the ends of the filaments the entire process can be followed through, and will amply repay any one for doing so.

[We have received three excellent mounted preparations of *Vaucheria* from Mr. Breckenfeld, which show some of the stages described above. The mounts are very neatly made and the specimens are well preserved. They are valued additions to our cabinet, and exceedingly interesting.—ED.]

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### Preparing Phosphorus Solution and Mounting in it.

In an article by A. W. Griffin on the 'Collection and Preparation of the



Diatomaceæ,' published in the *Journ. Postal Micr. Soc.*, the following instructions are given for preparing the highly refractive solution of phosphorus for mounting diatoms, etc. The author gives the refractive indices of various media employed as balsam 1.54, iodide of mercury solution 1.68, phosphorus 2.1. He then says:—

'It is necessary to procure clean, semi-transparent phosphorus, and having cut off, under water, some large pieces with a pen-knife, place them for a few seconds on a piece of white blotting paper, to free them from the slightest suspicion of water. Before commencing the operator should be provided with a small basin of water in which to place any article that has been touched with the phosphorus solution to prevent accidental combustion, and, as this medium is liable to oxidation, it is better to make but a small portion at a time; that is to say, one drachm of phosphorus to two drachms of bisulphide of carbon. When the former is quite dissolved, slightly damp a piece of filtering paper with bisulphide of carbon, and with a very small glass funnel placed in the neck of a stoppered bottle carefully filter the solution. Place the glass funnel and the filtering paper, when used, in the basin of water to prevent accident. Supposing the diatoms are preserved in a small tube of water and spirit, all that is required is to place a drop of the fluid on the cover-glass, and slowly evaporate the medium over the flame of a spirit-lamp or jet of gas. When the cover-glass has become quite cool, place on the margin of its edge a mere speck of Canada balsam, the object of which is to keep the cover, with its surface covered with diatoms, face downwards, in the centre of the glass slip. By means of a pipette, take a few drops of the solution of phosphorus and place them at the edge of the cover, and by capillary attraction they will be immediately drawn under, displacing the air in their progress.

'Having ascertained that the diatoms are completely immersed in the medium, remove all superfluous particles of phosphorus with a piece of blotting-paper, damped with bisulphide of carbon, and consign it also to a basin of water. Finally, place the slide on the turn-table, and with a brush dipped in Walton's glue-cine or Ray's coaguline, (the former we think the best,) draw a ring round the edge of the cover-glass. In all probability, this will be dry in the course of six hours, when, if necessary, another ring of the cement may be added, covering this with a further application of shellac varnish, or asphalt, as a last layer, any colored cement that the fancy of the operator may dictate.

'Diatoms that are almost indistinguishable in balsam show quite clearly in this medium. The structure of *Heliopelta* and *Omphalopelta* are brought out in a remarkable manner, and the same may be said of many of the varieties of *Navicula*, *Pleurosigma*, and *Nitzschia*.'

[We are not acquainted with either of the cements mentioned above, and the reader might find it difficult to obtain them. Although we have not had any experience in mounting with the solution of phosphorus, we venture to suggest a cement which will unquestionably serve perfectly well for the purpose. It is a solution of ordinary gelatin in water, colored slightly with potassic dichromate. A rather thick solution can be used to make a cell, if used warm on a warmed slide. When the mount is finished exposure to light for a short time after the gelatin is dry renders it quite insoluble. We can guarantee a cell thus made to serve the purpose well, for we once had occasion to make some large bisulphide of carbon prisms for a spectroscope. The prisms were cast in brass, and two sides were of plate glass, cemented on with common glue, to which some potassic dichromate had been added. The ce-

ment held for a long time—so long as the prisms were in use.—ED.]

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### New Members of the Infusorial Order Choano-Flagellata, S. K. —III.

BY ALFRED C. STOKES, M. D.

In continuation of this subject, which has become a very attractive one to me, and on which I have previously ventured to offer two papers to the readers of this JOURNAL, I now present the following notices of presumably undescribed forms of these minute but most beautiful infusoria, in this instance chiefly collected from small ponds in Western New York:

#### *Monosiga obovata*, sp. nov.

Body smooth, transparent, clavate or obovate, three and one-half to four times as long as broad, widest anteriorly, constricted at the line of insertion of the collar, and attached by the attenuate posterior extremity to the

Habitat.—Attached to the rootlets of Lemna in shallow ponds in Western New York.

The body bears a remote resemblance to that of *Monosiga angustata*, S. K. The creature conspicuously differs, however, in being elevated on the long pedicel, in being broader anteriorly, and in possessing a less attenuate posterior extremity. Its size is also very much greater. It is represented in Fig. 1, magnified 950 diameters.

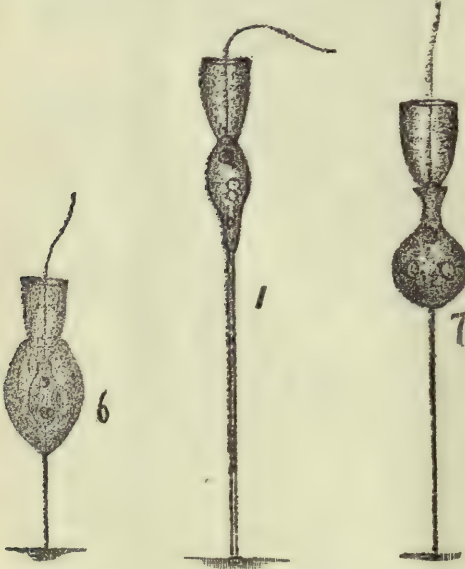
#### *Codosiga utriculus*, sp. nov.

Bodies elongate-obovate, widest in front of the transverse axis, slightly constricted at the point of insertion of the collar, three and one-half to four times as long as wide, attached by attenuate posterior extremities in clusters of four to the summit of a straight, rigid foot-stalk four to five times as long as the zooids, the pedicel occasionally becoming colored chestnut-brown after maturity; length of

body,  $\frac{1}{1250}$  inch. Habitat.—On Lemna rootlets in ponds in Western New York.

Several colonies of this species have been met with, among them a single one whose pedicel had assumed, presumably with age, a chestnut-brown color. So far as I am aware there is no record of such color change in connection with the pedicel of any member of the order, and when first observed with this species of *Codosiga* I thought it might possibly be restricted to it, since W. Saville Kent, who has made a special study of the order from English waters, has not recognized the change in any of the numerous forms which he has discovered. But it happens that one of the most beautiful and attractive species, *Codosiga umbellata* (Tatem) S.

K., with a compound pedicel resembling, as the specific name indicates, the clustered flower-stalks of the Umbelliferae, at times presents the same peculiarity. Several colonies have been observed in this condition. In-



summit of a rigid, comparatively thick foot-stalk about three times the zooid in length; collar narrow; nucleus and contractile vesicle conspicuous; length of the body, 0.0009 inch.

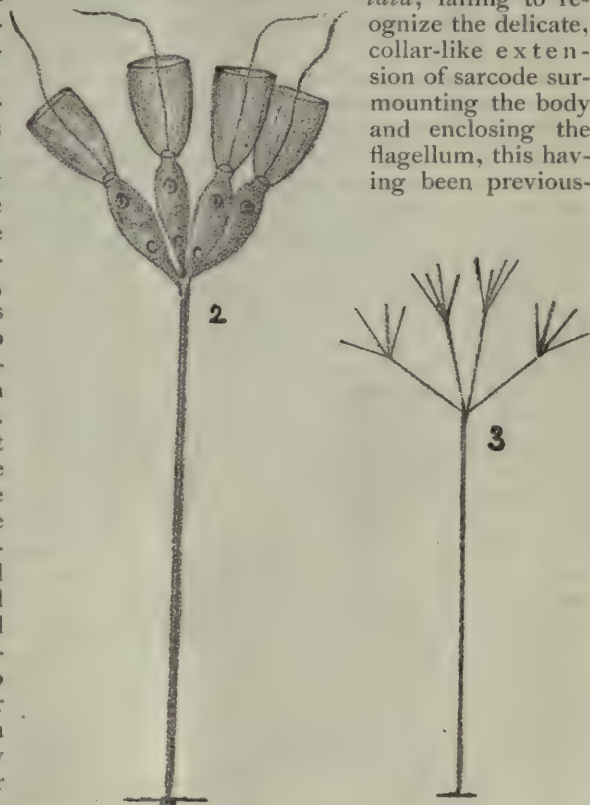


deed, the alteration is not confined to the foot-stalks of these two species, but occasionally even manifests itself in the stem of the very common and abundant *Codosiga botrytis* (Ehr.) S.K. It therefore seems probable that the change is not an abnormal one in any of the order. This alteration from a hyaline, slightly greenish tint to the translucent, chestnut-brown hue calls to mind a similar change of coloration, after maturity, in the loricae of *Cothurnia*, *Pyxicola*, and other members of the *Vagicolina*, and suggests the probability of a similar chemical composition.

A colony of *C. utriculus* is shown in fig. 2 magnified 625 diameters.

Kent describes a variety of *Codosiga umbellata* differing from his type only in the method of division of the foot-stalk, one having three branches to the main rachis and to each of the secondary divisions, the other with four to each of these parts. The English scientist states that the former is the more prevalent (indeed he has never met with the latter), and seems surprised that such should be the case, since it would appear so much easier and natural for a single collared zooid to undergo longitudinal fission four times and thus build up a colony whose primary foot-stalk should bear four branches, each of the latter also subdividing into the same number of branchlets. He furthermore questions, but finally accepts, the specific identity of the two forms, concluding that the colony supported by the bitripartite pedicel is the type, the quadripartite being a variety only, apparently basing his opinion upon the relative abundance of the former.

That these two methods of pedicel subdivision indicate two distinct species seems to me correct, but having recently obtained both forms of these elegant creatures in some profusion, I am inclined to the converse of the English scientist's opinion and to accept the quadripartite pedicel as that of the type, and the other, not as a variety, but as a distinct species. Tatem discovered and described the quadripartite colony as a new species of *Epistylis* under the name *E. umbellata*, failing to recognize the delicate, collar-like extension of sarcode surmounting the body and enclosing the flagellum, this having been previous-



ly accomplished by Prof. H. James Clark, in our own country. It would therefore seem only just, if there were no other reason, that the specific title should be restricted to those colonies with four branches to the main rachis with a quadrid subdivision of each into branchlets. Indeed, it is hardly probable, although possible, that crea-

tures so low in the scale of life should at one time undergo a threefold, and at another a four-fold, longitudinal fission. One can scarcely believe that their resources are so extensive, or their intelligence so well developed, that they can select so different a method apparently at will. Congenial surroundings and the presence or absence of suitable food might be supposed to exert a controlling influence, but when both species are found, as I have found them, attached almost side by side to the same *Lemna* rootlet, those suggestions seem to be of but little value.

As an appropriate designation for those colonies whose main rachis distally supports three branches I would suggest the name of the English writer who has made a special study of the charming members of the order, and propose that the species be known as *Codosiga Kentii*.

It is an interesting fact that the prevailing form in this country, if I may judge from my own observations, is the species with the quadripartite pedicel (Fig. 3, reduced from Kent), while the other obtains in England. In the little pond among the hills of Western New York, where I first saw them, the colonies occurred in abundance. Scarcely a *Lemna* rootlet came to the microscope stage without being ornamented by their crystalline arborescence, while the infinitesimal flagella lashed the water into microscopic whirlpools. Here the bi-tripartite species occurred so sparingly in proportion, that those with four divisions to the main stem with four branchlets to each formed ninety per cent. of the whole.

Since returning to my home in Trenton, I have observed several fine colonies of the quadripartite form with not only the main stem but the secondary branches as well, changed from the almost colorless state to the translucent brown tint. The alteration seems to be a favorite one with these exquisite creatures. Since then also, other colonies have been taken

which in some important particulars resemble the quadripartite form of *C. umbellata*, but differ in others as essential. The only way to be sure that the observer is studying a mature member of any genus of the Choano-Flagellata is to witness reproductive fission and the departure of the separated moiety. This, I presume, was accomplished by the discoverer of the bi-tripartite form, or variety as he considers it. But since Mr. Tatem in 1868 described the quadripartite footstalk as that of an *Epistylis*, it is reasonable to suppose that he did not witness the reproductive act, and that he may therefore have had an immature form of even the quadripartite colony beneath his objective. I am led to this supposition because I have recently obtained, near Trenton, colonies corresponding with the last mentioned in proportionate length of main rachis, in number and arrangement of secondary branches, and in the number of what would be the ultimate subdivisions of the latter; that is, corresponding up to those points at which the zooids would appear and be supported, but having those subdivisions, or branchlets, still further divided, where each, in those noted by myself, gives origin to four other stalks which thus increase the height of the colony and now act as the immediate supports of the animalcules, only two of the latter being attached to each ultimate stem. The collared infusorians correspond with those of the quadripartite form, the pedicel of which is depicted in Fig. 3, in shape, size and internal structure, the whole making, as I take it, the complete and mature example of *Codosiga umbellata*. The compound footstalk of this typical form is shown in Fig. 4, where it has not been thought necessary to delineate the collared monads, as they are not absolutely essential to the present purpose.

My hypothesis is further sustained by the fact that in Mr. Tatem's figure of his supposed *epistylis* four zooids are shown at the extremity of each



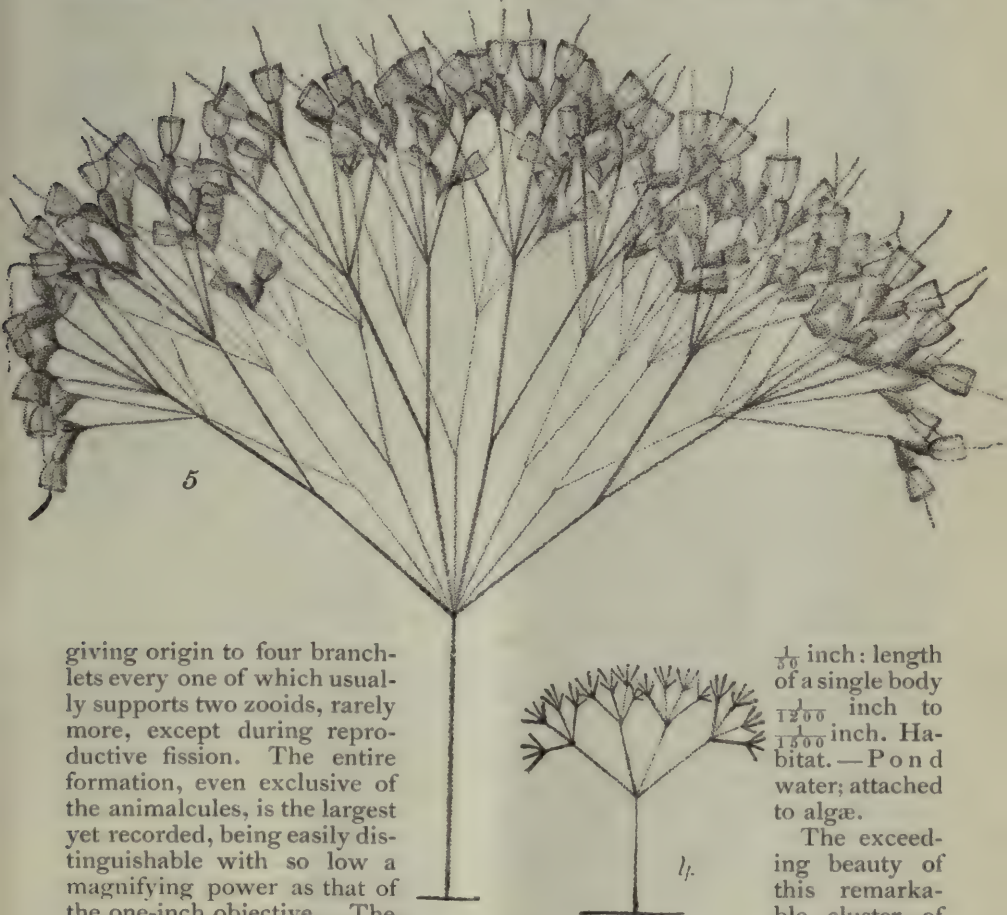
branchlet, while, as remarked by Kent in reference to his supposed bi-tripartite variety, the termination of each branchlet bears a considerable number of collared zooids.

Allied to what I therefore consider the complete and mature form of *C. umbellata* is a hitherto undescribed colony of the same genus, whose truly splendid aspect seems to demand recognition in the specific name *magnifica*. Its main stem is considerably longer than that of *C. umbellata* and bears just twice as many primary branches, each of these being furcated and each of these secondary branches

tion between it and other somewhat similar forms:

*Codosiga magnifica*, sp. nov.

Main stem bearing umbellately eight rigid, straight branches about one-half its own length, and bifurcated, each of the secondary branches subdividing into four branchlets, the summit of each of which usually supports two zooids resembling in form those of *C. umbellata*; main rachis ten to fifteen, the primary and secondary branches four to six, and the branchlets two to four, times as long as the body of a single zooid. Height of pedicel, exclusive of the bodies.



giving origin to four branchlets every one of which usually supports two zooids, rarely more, except during reproductive fission. The entire formation, even exclusive of the animalcules, is the largest yet recorded, being easily distinguishable with so low a magnifying power as that of the one-inch objective. The following description probably contains the principal points of distinc-

$\frac{1}{50}$  inch: length of a single body  
 $\frac{1}{1200}$  inch to  $\frac{1}{1500}$  inch. Habitat. — Pond water; attached to algæ.

The exceeding beauty of this remarkable cluster of

living creatures from an inconspicuous filament of alga in a humble mill-

pond, is almost destroyed by the treatment it necessarily receives from the writer's pencil. It would demand the artistic genius of a Leidy to delineate with scientific accuracy the charming symmetry into which the stenids divide themselves, the pleasing attitudes of the animalcules, the dainty grace of the entire arborescent atomy. As much as the writer's unskilful fingers can depict is exhibited in Fig. 5.\*

*Salpingæca sphaericola*, sp. nov.

Lorica pedicellate, ovate or subglobose, truncate anteriorly, the margin not everted, posteriorly rounded and somewhat narrowed at its junction with the pedicel; enclosed zooid ovoid, slightly constricted beneath the anterior margin, posteriorly inflated, occupying the centre of the lorica and attached to it through the intermedium of a thread-like, non-contractile ligament one-half its own length; collar long and narrow, somewhat more than one-half its length projecting beyond the aperture of the lorica; pedicel straight, rigid, equal or subequal to the lorica in height. Length of lorica 0.0006 inch, greatest width 0.0005 inch. Habitat.—Attached to rootlets of *Lemna* in shallow ponds in Western New York. Solitary.

When disturbed, especially when irritated by tapping the cover-glass with a needle, the body of the animalcule within the lorica quickly contracts into a spherical form balanced on the summit of the secondary pedicel within the sheath, after which it slowly resumes its normal outlines and protrudes the collar to the normal distance into the surrounding water.

Excepting this species, but two others have thus far been recorded in which the enclosed zooid is connected with the lorica by means of a posteriorly developed pedicel, those two being *Salpingæca petiolata*, S. K.

and *S. Clarkii*, Stein. In the latter, however, the thread-like prolongation is not constant, those individuals possessing it being considered abnormal or varietal. The discoverer of *S. petiolata*, a salt-water species, remarks that it may hereafter become advisable to relegate to a new genus all these forms of *Salpingæca* which are attached to their loricae by an independent pedicel. The remark may become just when the genus becomes unwieldy through a superabundance of specific members, but until that remote and improbable period arrives it will certainly be better to so extend the generic formula that the latter may include these rare and interesting pedicellate zooids.

Thus far but a single individual of the species here referred to has been observed. It is delineated in fig. 6 magnified about 800 diameters.

*Salpingæca lagena*, sp. nov.

Lorica pedicellate, flask-shaped, subglobose and inflated posteriorly, attached to the pedicel by the evenly rounded base, and produced anteriorly into a cylindrical neck everted at its distal extremity; the enclosed zooid taking the form of the lorica and often completely filling it; contractile vesicles, two or more, posteriorly placed and conspicuous; pedicel slender, straight, twice to two and one-half times as long as the lorica. Length of lorica  $\frac{1}{2500}$  inch. Habitat.—Attached to various algæ and aquatic plants from ponds in New Jersey. Solitary.

This form (Fig. 7) resembles *Salpingæca amphoridium*, J. Clk. lifted on a long foot-stalk, and differs from all known pedicellate species in the evenly rounded contour of the lorica base. It has thus far been met with only in one locality, a small pond to which there is no visible outlet, whose surface is densely covered by *Lemna polyrrhiza*, to whose rootlets and to the net-work of the veins of decaying leaves the loricae are sparingly attached.

TRENTON, N. J.

\* By an error in drawing the figure has been made with nine branches to the main stem.



## Photographic Methods.

BY C. M. VORCE, F. R. M. S.

### I.—FORMULAS FOR PRINTING SOLUTIONS.

*Blue Prints.* The best formula for this process, of many that I have tried, is that furnished by Prof. C. H. Kain, of Camden, N. J., in which the quantity of ammonio-citrate of iron is exactly double that of the red prussiate of potash, and the solutions strong. This gives strong prints of a bright dark blue, and prints very quickly in clear sunlight.

Dissolve 6 grains of red prussiate of potash in 1 dram of distilled water; in another dram of distilled water dissolve 12 grains of ammonio-citrate of iron. (I use Powers & Wightman's make.) Mix the two solutions in a cup or saucer, and at once brush over the surface of clean, strong paper. Cover the surface thoroughly, but apply no more than the paper will take up at once; it should become limp and moist, but not wet. The above quantity of solution, 2 drams, will suffice to sensitize ten square feet of paper, or 3 sheets of the 'regular' size of plain paper, 18 × 22. As fast as the sheets are washed over with the solution hang them up to dry by one corner. The surplus fluid will collect in a drop at the lower corner, and can be blotted off.

*Black Prints.* Wash the paper with a saturated solution of bichromate of potash, made quite acid with acetic acid. After printing wash the prints in running water for 20 to 30 minutes; then float them face down on a weak solution (5 to 10 per cent.) of protosulphate of iron for 5 minutes, and wash as before. If preferred, the iron solution may be washed over the prints, or they may be immersed in it, but floating seems preferable. After the second washing wash the prints over with a strong solution of pyrogalllic acid, when the print will develop black, and the ground, if the washings were sufficient, will remain white. A final washing completes the process.

If a solution of yellow prussiate of potash be used in place of the pyrosolution a blue print is obtained. Bichromate prints can be made on albumenized paper by floating it on the solution, and by using a saturated solution of protosulphate of iron and a saturated solution of gallic acid. Very fine prints can be so produced nearly equal to silver prints and at somewhat less cost, but with little or no saving of time or labor.

*Cheap Proof Solution.* If old oxalate developer be exposed in a shallow vessel in a warm place a deposit of light green crystals will be formed, composed of an impure oxalate of iron. If these crystals be dissolved in water and paper washed with a strong solution, when dry it may be exposed in the printing frame, giving full time. The image is very faint, but on washing in, or floating on, a moderately strong solution of red prussiate of potash for a minute or less a blue positive is produced, which is washed in water as usual to fix it. The unused developer produces the best crystals for the purpose, and the pure ammonio-oxalate of iron is vastly better than either.

All of the above operations, except the printing, should be carried on in the dark room, or by lamp or gas-light only. The solutions and the paper should also be kept in the dark and prepared as short a time as possible before use.

### II.—COMPOUND NEGATIVES.

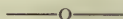
In photography with the microscope it frequently occurs that the operator, instead of devoting a negative to each of two or more similar objects for comparison, printing both upon the same print, prefers to have the whole series upon one negative, and taking from this a single print. There is often room for two or more images upon the same plate. If the centre of the plate is devoted to one, obviously no more can be accommodated on it, but by placing one at each end, or one on each quarter of the plate, both economy of plates and

convenience of printing are secured. The end may be readily accomplished by matting the plate as a negative is matted in printing.

Suppose it be desired to photograph four different species of acari on one plate, the image of each when magnified to the desired extent only covering about one-fourth the exposed area of the plate. First a mat is prepared of card-board or thick non-actinic paper which is adjusted to exactly fill the opening of the plate holder, lying in front of and close against the plate when exposed, and having one quarter very exactly cut out. A convenient way to fit this mat is to leave projecting lugs on each side at exactly the same distance from the ends, and cut notches in the plate holder into which the lugs may closely fit. If this work is carefully done the mat may be reversed both sidewise and endwise, and the lugs will fit the notches; if so, it is ready for use. The object being focussed upon the focussing glass or card, the camera is raised one-half the vertical dimension of the plate and displaced to one side half the horizontal dimension, when the image will be found to occupy one-quarter of the plate. The mat being placed in the plate holder, a focussing glass is inserted in the position the plate will occupy and final adjustment and focussing made. The plate is then taken on one corner on the film side with a lead pencil, placed in the holder without disturbing the mat, and the exposure made. When the plate is replaced for a second exposure either the mat is reversed or the plate turned end for end; but it is best to always place the plate in the holder in the same position and change the mat to expose successive quarters, but this requires the camera to be moved for each exposure.

With similar objects, and some judgment in making the exposures, negatives may be made with almost

exactly the same density in each quarter, and by cutting out slightly less than one-quarter of the mat the four images will be separated by black lines in the print; by cutting out a trifle more than the exact quarter they will be separated by white lines instead of black.



### The Iris Illuminator.\*

BY R. H. WARD, M. D., F. R. M. S.

One who has employed the various forms of graduating diaphragm can scarcely fail to appreciate the luxury of being thus able to regulate with precision the amount of light employed, and the breadth of the illuminating pencil, without abrupt change, and while the object is under uninterrupted observation. Heretofore, however, this expedient seems to have been applied only to axial illumination. For the sake of attaining similar advantages with oblique illumination, the writer has devised and used a combination believed to be new, which, for want of a more correct name, he calls the "Iris Illuminator." It consists, as shown in Fig. 7, of any desired lens system, either dry or

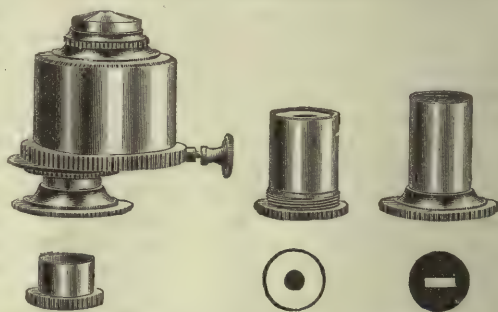


FIG. 7.—Iris Illuminator.

immersion, under and close to which is mounted an iris diaphragm, with a decentering adjustment; the diaphragm being set in a sliding plate moved by a screw or lever, so that it can be moved into any position from the centre to the periphery of the system, without altering the position of

\* Read before the American Society of Microscopists, 1884.



the latter. Thus not only the obliquity of the light but the exact amount desired or found advantageous of any chosen obliquity can be regulated with perfect precision by a touch of the hand to the decentering screw and to the adjusting collar of the diaphragm.

A blue glass disk for correcting the glare and color of gas or lamp light is fitted to the bottom of the dark-well of the diaphragm. A special adapter is also provided for the use of central stops for dark-field illumination; or of a horizontal slit or pair of horizontally arranged apertures, for the better illumination of binocular microscopes, as proposed by the writer in the *Am. Nat.* for Dec., 1870, and since adopted by several makers; or of any special stops desired by the user; or of a polarizing prism and selenite plate. The whole apparatus rotates about its own optical axis, which remains coincident with that of the microscope itself.

This appliance is well adapted to any lens system of moderate size. It is used, perhaps, to the best advantage with a 4-10ths achromatic condenser, or with the thick, non-achromatic immersion lenses adopted by and named after Prof. Abbe, of Jena; the latter being, apparently, preferable to the best achromatic combinations for illuminating purposes.

By removing the lenses from the top of the apparatus, the iris diaphragm, with or without the blue glass disk or the polarizing prism, will be found in position for use by itself. Except for very low powers, however, or for extreme resolving work on lined objects, the illuminator may be considered a part of the stand, and kept habitually in place, the changes of light required for a great variety of work being more rapidly and perfectly accomplished by its aid than without. It is made by the Bausch & Lomb Optical Co., of Rochester, and can be applied to almost any microscope, whether with or without a substage.

## Copulation of *Diffugia Globulosus*, Duj.\*

BY DR. CARL F. JICKELI.

Copulation and conjugation have been so seldom observed in rhizopods, and the few accounts of this kind permit in part of another explanation, especially since the observations of A. Gruber upon the processes of division of *Eaglypha alveolata*, one justly regards many such observations with distrust. For these reasons I describe a process of copulation of *Diffugia globulosa* which I observed in December of last year, in Jena.

One morning I found in a watch-glass, in which I was breeding infusoria and rhizopods, two specimens of *Diffugia* united. The little animals were joined with the mouth-openings together. Their shells were entirely filled with protoplasm and from them extended four very long and uncommonly active pseudopodia from the place of union of the two individuals. The shells were of the same size, but the one much more transparent than the other. Isolating the creatures by means of a fine pipette, they remained united. About the same hour of the morning of the following day, after twenty-four hours, the animals were still united, both shells entirely filled with protoplasm, but the pseudopodal action had ceased, and at the point of union of the mouth-openings not the smallest plasma filament was to be seen. Examination after twelve hours more, thirty-six hours after the first observation, showed no change, both shells laid as in the morning full of protoplasm, without the slightest trace of pseudopodal formation. Still twelve hours later, forty-eight after the discovery of the condition, both shells were separated.

After treatment with osmium-chromacetic acid and staining with picrocarmine both shells were enclosed in lack cells. By carefully crushing

\* Translated for this Journal from *Zoologischer Anzeiger*.

them it was seen that only one of them was filled with protoplasm; the other, on the contrary, was entirely empty. I was able to observe, from certain peculiarities, that the shell before distinguished as the clearer was now the empty one. In the isolated plasma of the darker colored shell I found two entire, and one disintegrated nucleus. The two entire nuclei revealed a large number of smaller, darker-colored bodies in a less deeply colored ground-substance, and surrounding them was distinguished an evident double contoured uncolored nucleus-membrane. Among the remains of the third nucleus could be distinguished, more or less clearly, within the less deeply colored general mass, a darker colored central body.

I have alluded to the process described as copulation, although I have not observed the union of originally separated individuals. Since in no case can we regard it as a division, it may only be said against my assumption that it might be a process of rejuvenation, in which one animal has constructed a new dwelling around its protoplasm, and forsaken its old one. I believe this objection is disposed of by the observation of the active pseudopodal action at the beginning of the process, by the destruction of the one nucleus, and also by the fact that not the clear but the darker shell, at the end of the whole process, contained the plasma-body. All this does not accord with the appearances observed in rejuvenation. I will not neglect to add, that a large number of diffugia, of the same species, which were found in the same watch-glass, after careful observation, all showed only one or two nuclei, each nucleus with a single large nucleolus.

If I am not, then, at fault in considering the observed process as copulation, the following facts result:—

1. Copulation takes place among rhizopods as among infusoria.
2. As among infusoria, during copulation there also occurs a stage of low vital energy.

3. In course of the processes a destruction of the cell-nucleus takes place.

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## EDITORIAL.

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**Publisher's Notices.**—All communications, remittances, exchanges, etc., should be addressed to the Editor, P. O. Box 630, Washington, D. C.

Remittances should be made by postal notes, money orders, or by money sent in registered letters. Drafts should be made payable in Washington, New York, Boston, or Philadelphia.

Subscription-price before April 1st, \$1 per year, in advance. All subscriptions begin with the January number. After April 1st the subscription-price will be \$1.50.

The regular receipt of the JOURNAL, which is issued on the 15th of each month, will be an acknowledgment of payment.

The first volume, 1880, is entirely out of print. The succeeding volumes will be sent by the publisher for the prices given below, which are net.

- Vol. II (1881) complete, \$1.50.
  - Vol. III (1882) complete, \$2.00.
  - Vol. IV (1883) complete, \$1.50.
  - Vol. V (1884) complete, \$1.50.
  - Vol. V (1884), Nos. 2-12, \$1.00.
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## MICROSCOPIC METEORITES.—

There are constantly floating in the air, and falling to the earth from space, minute particles of impalpable dust. On the snow-clad summits of mountains, on the ice and snow of the polar regions, and at the bottom of the sea, these particles slowly accumulate, and occasionally they are collected and studied microscopically and chemically. While some of this dust may readily be recognized as of terrestrial origin, much of it is undoubtedly of a meteoric character—cosmic dust, unlike anything else known upon the earth. An alloy of nickel, cobalt and iron is not known to occur anywhere upon the earth, but metallic spherules containing these metals were found on the ice-fields of Greenland, and spherules of iron have also been found in the abyssal depths of the ocean, which are supposed to have the same origin. Perhaps they are from the luminous trains of meteorites or shooting-stars, which, losing their incandescence, sink as impalpable dust upon the polar snows, or into the still ocean depths, where the deposits form so slowly that the dust from space is not covered up, but remains on the surface of the bottom.



Nordenskiöld found large cavities in the ice of Greenland filled with a fine mud which contained spherules of iron, nickel and cobalt. The mud was supposed to be derived from space, the *débris* of planetary bodies. It was estimated that the deposit weighed several hundred tons on each square kilometer of surface, from which one may conceive that the quantity of cosmic dust that finds its way to the earth in the course of ages is considerable.

—o—  
EGGS OF THE HOUSE-FLY.—One of the articles in *Science Gossip*, entitled 'Graphic Microscopy,' by E. T. D., is devoted to the eggs of the house-fly, with a colored lithograph. The author treats his subjects in a popular and interesting way. As regards the eggs of the house-fly he says: 'The common house-fly (*Musa domestica*), ubiquitous, residentiary, and numerous as it may seem in the dwelling-house, even invading the sacred drawing-room, is found in far greater numbers in gardens and the surroundings of domestic offices; and it is only in obscure and neglected places where their elegantly-winged eggs are discovered, under circumstances depending on the economy of the creature, where the larvæ when hatched find sustenance, generally in most putrefying substances; under such conditions, 60 to 80 eggs are deposited, in groups of a few; the laying is repeated after intervals, the eggs hatch in two or three days, and the perfect insect so quickly arrives at maturity that it has been calculated and placed on authoritative record, a single female, in one season, through four generations, may produce two million descendants.'

When the eggs are found, which will be only after careful search, they can be mounted as permanent objects. The plan recommended by E. T. D. is to dip them in water at a temperature slightly below the boiling point. This destroys vitality, and they may be dried and mounted as opaque objects.

If some readers will search for the eggs of flies next season and mount them neatly, the preparations would be in demand for exchange. The postal-club should have a preparation of the kind when the boxes are filled again.

—o—  
THE NEW YORK MICROSCOPICAL SOCIETY.—We had the pleasure of attending the meeting of this society on the evening of January 2d, the first we have been able to attend for nearly two years. It was with much satisfaction that we found the society in a flourishing condition. It has grown very rapidly, and has now a membership of about eighty.

There is a healthful condition of activity manifested in the meetings, which apparently is not due to any transient stimulation, but is the natural result of steady growth, fostered by the conservative and business-like manner in which the society has been conducted.

Among the first fruits of this flourishing condition of the society is a monthly edition of the 'Proceedings,' the first number of which will probably be issued this month. The existence of this publication is due to the liberality of some of the members, who have subscribed a sufficient sum to establish it. The intention is to make it the organ of the society to secure exchanges from other associations, and although it is offered as a monthly publication to subscribers outside the society, it is not supposed that the expenses of publication will be met by subscriptions thus received. It will contain reports of the meetings, papers read, and the discussions, and in addition translations from foreign journals.

While we can heartily approve of the publication of 'Proceedings' by the New York society, and while we have long looked forward to the time when such a publication would be possible, we would wish that a somewhat different scheme might be adopted and carried out, more in keeping

with the position which the society should occupy. We fear there will be a tendency toward dillitancy in such a publication. There is enough of elementary microscopy in our own paper, but even were it otherwise, the reader would look for something more strictly scientific in the 'Proceedings' of a society.

There is a want in this country which the society is now in a position to meet. If, instead of a monthly paper, only partly filled with matters brought before the society, a publication should be established with the same money, to be issued either quarterly or even at irregular intervals, giving a stated number of pages each year, devoted to the publication and adequate illustration of strictly scientific papers, the society would be doing a meritorious and much-needed work, which would entitle it to rank among the best associations of the land. The expense of publishing, and especially of illustrating, scientific articles is a great hindrance to the progress of good work in this country, and if this society would afford a medium for such work to be published, the benefits would be far-reaching indeed.

While by no means wishing to discourage in any way the promoters of the present scheme from carrying it out with all energy and ambition, we still trust it may lead to something such as we have suggested above. If money is to be expended on behalf of the society, let it be done wisely, and in such a manner as will foster and encourage scientific work of a high character, as well as give the society itself a high position.

—o—

SCIENCE, TRUE AND FALSE.—It is with sincere regret that in the pages of publications ostensibly scientific in character, we occasionally find articles which are unworthy of the name scientific, written with an evident want of foresight, if not of knowledge. Some publishers, taking advantage of a certain tendency of the age, have

been reaping rich harvests from newspapers which purport to be devoted to science, but which attract uncritical readers by high-sounding titles, and articles of a sensational, but very unscientific character. It is positively astonishing that some of these papers can exist for half a year, so obviously are they mere organs to give notoriety to some crank who edits them, or to put money into the pocket of publishers, through the medium of advertisements. Yet some of them run on through five, six or ten years, and apparently flourish far better than any of the higher class of publications.

If the general public is so readily deceived, and so utterly incapable of distinguishing pure humbug from sound knowledge; or if the great public, as Mr. Barnum is credited with having said, likes to be humbugged, it is not strange that, even among microscopists, there should be a few who are deceived, as one may say, by sounding brass or a tinkling cymbal.

Fortunately, microscopical literature is comparatively free from the pure article of unadulterated humbug, although occasionally it crops out, in the newspapers, and now and then in papers whose editors ought to know better, to astonish the general reader and amuse the scientist.

Microscopical literature, however, in this country at least, has of late abounded in another kind of reading matter, which, if we correctly appreciate the tastes of the average reader, is even more offensive than pure nonsense. We allude to uninteresting, useless, offensive, and even occasionally insulting personalities. They do no good to either writer or reader, they do no harm except to the one who indites them. They are low, and vulgar, and disgraceful. Not only do they lower the tone of the papers in which they are found, but they give a false impression as to the character of the American reading public, when they go abroad and are read by persons in foreign lands, who



are too readily confirmed in their already firmly rooted belief that Americans are still almost barbarians.

When we read some of these things, and consider that the papers which publish them apparently receive the support of American readers, we are prone to think there must be a degraded taste that tolerates them ; but reason, coming to our aid, dispels such an unjust conclusion, for it becomes evident that such papers cannot possibly be conducted by persons imbued with the spirit of true science, and therefore cannot hope to be sustained by scientific readers, but must rely almost entirely upon advertising patronage for support.

These thoughts have been called forth by reading an article by Prof. E. L. Youmans, in *Popular Science Monthly*, in which the spirit of pure science, which should, and, indeed, must actuate every earnest student in the pursuit of truth, is expressed. Let us draw a contrast in our minds between the petty jealousies, the mean subterfuges, and the bold pretensions which the critical reader may find under the guise of science, whether among professors, writers, or editors, and the thoughts expressed below, how small and narrow is the mental calibre of the one class, how broad and pure and noble is the spirit of science as thus expressed. Professor Youmans says :—

‘The dominant ideas of the past have been confining and restrictive. National feelings are diverse and antagonizing ; religions are hostile, and politics local and exclusive ; but science is as universal as Nature, its devotees are one in spirit and in purpose, and it is undoubtedly the supreme unifying element of the modern social state. It studies phenomena of every kind, and is equally at home in every place. Its perpetual aim is the dispassionate consideration of facts, and the generalization of wider and more comprehensive truths. Eschewing all narrowness and prejudice, by the very nature of its discipline it

tends to break down factitious limitations, it cultivates the spirit of large-mindedness, and is the great teacher or toleration, liberality, and catholicity. By leading to profounder agreements, by awakening broader sympathies, and making possible more harmonious co-operations in the further progress of civilization, the extension of science is full of hopeful encouragement for the best interests of mankind. Under its influence men emerge into the light of new intellectual relations, new opportunities, and new responsibilities. The elevated sentiments by which men of science are more and more animated were thus eloquently expressed by one of the distinguished presidents of the British Association, Sir John Herschel. He said : “Let selfish interests divide the worldly, let jealousies torment the envious ; we breathe a purer empyrean. The common pursuit of truth is of itself a brotherhood. In these meetings we have a source of delight which draws us together, and inspires us with a sense of unity. That astronomers should congregate to talk of the stars and planets ; chemists, of atoms ; geologists, of strata, is natural enough ; but what is there, equally pervading all, which causes their hearts to burn within them for mutual unbosoming ? Surely the answer of each and all—the chemist, the astronomer, the physiologist, the electrician, the biologist, the geologist—all with one accord, and each in the language of his own science, would answer, not only the wonderful works of God, and the delight their disclosure affords, but the privilege he feels to have aided in the disclosure. We are further led to look onward through the vista of time with chastened assurance that Science has still other and nobler work to do than any she has yet attempted.”’

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## NOTES.

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— There seems to be a considerable demand for mounted specimens of properly

identified bacteria, particularly abroad. Mr. Emmerich has ordered a series of preparations to meet such a demand here, and will doubtless be prepared to fill orders for them by the time this journal is issued. Some of them are mentioned in his advertisement, the most notable of which is the comma bacillus of cholera.

— Messrs. H. R. Spencer & Co. are preparing a new price-list of their objectives, which will doubtless be ready by the time these lines are printed. With increased facilities for manufacture and good business connections, they propose to fill orders more promptly than heretofore. They now make a non-adjusting homogeneous immersion objective of a new series, which they maintain as 'hard to beat for finish, price and power.'

— The mounted preparations of pathogenic bacteria, advertised by Dr. Abbott this month, will doubtless prove very desirable additions of the collections of microscopists and especially of physicians. Dr. Abbott is assisting Dr. G. M. Sternberg in his laboratory, and therefore has special facilities for obtaining pure cultures of pathogenic bacteria, and pathological material of an interesting nature.

— Dr. Sternberg informs us that he has just obtained a pure culture of the micrococcus of swine-plague, which was proved by Dr. D. E. Salmon to be the cause of the disease. Although Dr. Salmon's conclusions have been called in question by Dr. Klein, the evidence upon which they were founded is too strong to readily overthrow, particularly since he has lately succeeded perfectly in producing the disease with pure cultures. It is therefore interesting to know that Dr. Sternberg has also obtained the micrococcus.

— Mr. T. Smith has called our attention to an error in our last number, on page 225, where, in describing the method of sterilizing the potato for cultures of bacteria, we stated that the cut slices should be dropped into a solution of corrosive sublimate. It appears that the object of the corrosive sublimate solution is to kill the spores on the outside of the potato—attached to the skin—and the whole potato is, therefore, dropped into the solution before the slices are cut.

— What Mr. Tuffen West writes is usually excellent, but when he tells us, as in the *Journ. Post. Micr. Club*, that 'black-ground illumination is a poor way of getting at the facts which a specimen may disclose; so also is polarizing,' we are not

prepared to follow him so well as usual. On the contrary, we should say that black-ground illumination is sometimes absolutely necessary to enable one to properly study a specimen. We have in mind just now an elegant preparation of a peristome of a moss, and not only is it a far more beautiful object when seen with a dark field, but its structure is not fully revealed in any other way. As regards 'polarizing,' by which is doubtless meant the use of polarized light, what would a mineralogist, for example, do without it? Surely Mr. West did not mean to make such a sweeping assertion as his words express. One might as well say—as Mr. E. M. Nelson does—that the use of oblique light in microscopy is not desirable.

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## CORRESPONDENCE.

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### Mosquitoes and their Scales.

TO THE EDITOR:—At the risk of provoking jealousy between New Jersey and Long Island, I will tell how I procured the material from which my slide of mosquito scales, referred to in the November number of the JOURNAL, was obtained. Driving on Long Island we encountered a swarm of mosquitoes so thick that we had to brush them away from before our faces in order to see the horse. Bethinking ourselves that we had with us some large-mouthed ounce vials for collecting purposes, we removed the cork from one of them, and it was soon filled with live and lively mosquitoes. Replacing the cork, they died, but not until they had well denuded themselves of their scales. This was three seasons ago, and although I have made many slides of mosquito scales since that time, my supply shows little signs of diminution. This may seem like a mosquito story, but for its verification I can still show those identical mosquitoes.

M. A. BOOTH.  
LONGMEADOW, MASS., Nov., 1884.

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## Exchanges.

[Exchanges are inserted in this column without charge. They will be strictly limited to mounted objects, and material for mounting.]

Exchanges by list of all kinds of first-class material for mounting solicited.  
A. M. BOOTH,  
Longmeadow, Mass.

Unmounted material and labels for slides in exchange for good slides.

EUGENE PINCKNEY,  
Dixon, Ill.

Fossil Diatomaceous Earth, (a new find), very interesting forms for other material.

J. WALKER,  
810 Twelfth Ave., South Minneapolis, Minn.



# THE AMERICAN MONTHLY MICROSCOPICAL JOURNAL.

VOL. VI.

WASHINGTON, D. C., FEBRUARY, 1885.

No. 2.

## The Microbe of Yellow Fever— Preventive Inoculation.

BY M. M. D. FREIRE AND REBOURGEON.\*

In 1880 Dr. Domingo Freire, professor of biology in the medical faculty at Rio Janeiro, in a memoir which appeared based on his scientific work, had already published the result of his first discoveries regarding the microbe of yellow fever and regarding the employment of salicylate of soda as a curative means. Since that time M. Freire has not ceased to study the question, regarding it indeed from the true point of view, namely, the microbial nature of this fever, the possible culture of the microbe, its physiological and chemical transformations, and finally its attenuation. To-day, after a rigorous experimentation, M. Freire gives the proofs of the contagion, and demonstrates the existence of *ptomaine* in the cases of yellow fever, of which he indicates the character. The culture of the micro-organism and the artificial reproduction of the blackish matter of the vomiting, the infecto-contagious nature of the malady, and finally the inoculation-preventive by aid of a liquid attenuated by culture, have been the object of his researches.

When the blood of a subject recently deceased from yellow fever is examined, or, better still, the blood of an inoculated animal at the point of death by the same disease, there may be seen in the field of the microscope: 1. A considerable quantity of extremely small micrococci, hyaline

in appearance. 2. Cellular bodies attaining only one-fourth the volume of a blood-corpuscle. 3. The same cellular bodies larger and more opaque. 4. Large cellules affecting the form of an epithelial cellule of a blackish aspect, showing their torn enveloping coats and permitting to escape a quantity of the above described micrococci.

On the other hand, if in a bouillon devoted to culture by surrounding it with the required precautions, we seek to cultivate the micrococcus found in the blood, at the temperature of  $38^{\circ}$  to  $39^{\circ}$ , we see in a few hours its successive transformations and passage through all the states which have been just indicated. If we leave the liquid in repose the inferior part becomes entirely blackish; microscopic observation demonstrates that this deposit is only formed of the cellular envelopes of the micro-organism which has reached the last period of its action. Chemical analysis demonstrates besides that this cellular envelope is transformed into *ptomaine*. It is then easy to deduce from this series of observations that the yellow fever is determined by the presence in the blood of a cryptococcus which follows rapidly all its phases of evolution, and that the blackish matter of the vomiting, or of the dejections of sick persons, is formed only of the debris of this same cryptococcus which has become poison by its transformation into *ptomaine*, and not by the removal of the blood corpuscles through hemorrhage as has been believed for a long time.

Encouraged by his successive discoveries, and proceeding always with

\* A paper presented to the French Academy by M. Bouley. Translated by A. N. Skinner from *Comptes Rendus*, November 10th, 1884.

the necessary experimental rigor. M. Freire has accomplished the attenuation of the virus of the fever in a culture liquor, and the transformation of it into a mild or vaccinal virus. In the month of last November the Emperor of Brazil, that illustrious Mæcenas of science, assisted by the ministry of the Empire and the principal members of the medical faculty, wished to perpetuate the work of M. Freire, and authority was given to begin the vaccination of human beings. The facts given by us have not been tardy in producing results, and in four months the number vaccinated exceeded four hundred.

The phenomena observed to follow vaccination are only those which are noticed in a very mild yellow fever: intra-orbital and supra-orbicular pains; very intense cephalalgia; loss of appetite; elevation of temperature; lassitude in the limbs. But all these symptoms cease at the end of two or three days at the most, and the subject returns to health. If the blood of a vaccinated case is examined some hours after inoculation, the micrococcus of yellow fever is found in the blood, but its enveloping coat is no longer transformed into *ptomaine*; it is consequently no longer a poison, and is absorbed little by little and finally disappears.

The experimenation has not yet been able to demonstrate for how long a time the immunity conferred by this preventive inoculation will continue; but this immunity at the outset is absolutely certain, and examples the most striking have demonstrated it to us. Amidst us large numbers of those inoculated have been able to live in localities positively contaminated, seeing every day around them the yellow fever thinning out the ranks without experiencing the slightest attack of the malady. We have seen likewise in the course of our experiments at that time, under the influence of the high temperatures of these regions, the laboratories to become literally invaded by the mi-

crobe, animals recently purchased as subjects of experiment to die of yellow fever spontaneously and in a few hours, while certain others inoculated for prevention have perfectly resisted, giving all the signs of perfect health.

I close by claiming to establish for M. Freire the question of priority, and in promising to give very soon new details, supported always by experiment.

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### The Study of Vegetable Fibres.

In the National Museum there is a large and valuable collection of textile fibres, which shows that the world is by no means dependent upon the best known fibre-yielding plants, cotton, hemp, flax, and jute, for its textile fabrics. Cotton and linen cloths are so common and so cheap among us that we scarcely think of the possibility of any substitutes for them. Yet in other lands the conditions may be very different; and it is interesting to look back among the early inhabitants of the world, and trace the progress of the textile industry through its various stages. We see how each nation has learned to utilize the materials nature has provided; where cotton was abundant it was woven into cloth, where the flax and hemp flourished their valuable fibres were extracted; fine linen is a very ancient fabric. This part of the subject, however interesting, cannot be dwelt upon here, nor can we refer to the circumstances which have led many persons to spend much time and money in the cultivation of other fibrous plants, and inventing machinery to extract the fibres from them. It would seem that nothing could supersede cotton for spinning and weaving such fabrics as are most constantly in demand. Yet it may be that the time is not far distant when it can no longer be said that 'cotton is king.' Even now it has a rival in the ramie, the Chinese nettle, *Bahmeria nivea*, in the fineness to which it can be spun, for the pure white, silken fibres of the ramie,



some beautiful specimens of which are in the National Museum, have furnished a thread so fine that one pound of it would measure 77,000 yards.

For experimental purposes cotton has been spun very much finer. The finest cotton thread of which we have any knowledge was mentioned on page 217 of vol. ii of this JOURNAL where it is stated that a pound of cotton has been spun into a yarn over 715 miles in length. This represents 1,258,400 yards, and would correspond to number 1500 thread. Where this was done we do not know, as the record we have does not specify the mill. The Willimantic Linen Company, of Connecticut, has spun some thread almost as fine. This company has spun cotton thread as fine as number 1,100, which would give 924,000 yards to the pound.

The extreme fineness of this thread may be better appreciated when it is said that the finest thread in demand is number 200, and few persons use anything finer than 150. We have some specimens of 400 three-cord thread, 112,000 yards to the pound, from the Willimantic Company which measures about  $100\mu$  or .0039 inch in diameter. This represents the diameter of three threads twisted together, from which some idea of the extreme fineness of the higher numbers may be formed.

There are many plants growing in different parts of the world which are of more or less value as sources of textile fibres; some of them are only useful where they grow for making ropes, or nets for fishing, others have already acquired more or less commercial importance, and are used in the manufacture of paper or for mixing with more valuable fibres in spinning.

It becomes, then, a matter of considerable importance to be able to distinguish fibres of different kinds in woven fabrics, and this is only possible by the aid of the microscope.

The microscopical examination of

fibres also leads to more than a knowledge of the peculiarities of fibres and the means of distinguishing between them. In the hands of experienced persons the microscope throws much light upon questions of practical importance to spinners of yarns and to dyers. This is a branch of the subject that is too technical for this place. It may be said, however, that the value of a fibre for spinning depends upon its fineness, suppleness, length, and strength. In the case of wool we have the further qualities of natural curliness and imbricated surface, which causes the fibres to cohere and mat together. The ramie is exceedingly well adapted to spinning, the fibre being very soft, averaging about 120mm. in length. Obviously it has a great advantage over cotton in respect of length. The cotton fibre, however, makes durable garments by reason of its great softness and flexibility, due to the purity of the cellulose of which it is composed.

In this article we shall confine ourselves to the examination of fibres from the vegetable kingdom.

The best authority upon the microscopical characters of vegetable fibres is M. Vétillart, whose valuable work, '*Etudes sur les fibres*,' is the most complete yet published, although it only treats at length of a comparatively small number of the textile fibres now more or less used. M. Vétillart examines fibres in several ways, and one cannot do better than follow the course he has laid down. We shall give the method of examination as carried out in the National Museum for the examination of fibres, and the method of mounting specimens for microscopical study, or for reference and comparison.

The fibres are first separated from each other, so that single ones can be readily collected and isolated. In most cases a simple soaking or boiling in water suffices to effect the separation, but if not, boiling in a weak solution of washing soda soon removes the resinous or gummy ma-

terial which binds them together, and makes them readily separate when pulled apart with needles. The soda should be thoroughly washed out, when the fibres may be allowed to dry.

The microscopical examination is conducted in a mixture of equal parts of water and glycerin. The fibres are placed in the mixture or on a slide, a  $\frac{1}{8}$ -inch cover-glass applied, and the examination conducted with a  $\frac{3}{8}$  and a  $\frac{1}{2}$  objective. The general character of the fibre is thus quickly made out, and if it should be one of the more common forms, it would be immediately recognized. If it should be a fibre with which the observer is not familiar, it is first examined carefully, the diameter of the fibres measured, and the appearance of the ends particularly noted. The next step is to treat it with reagents, unless it should seem desirable to measure the length of the fibres at this stage. The length is measured by stretching some of the fibres out on a slip of glass, in water or glycerin, and measuring their length in any convenient way.

Two reagents are used in the examination of fibres, one a solution of iodine, which is allowed to act for a few moments, and then followed by the second, which is sulphuric acid of a certain strength.

The iodine solution is prepared by dissolving one gramme of potassium iodide in 100 c. c. of water, and adding iodine to saturation, leaving a portion of iodine undissolved in the fluid to maintain its strength.

The sulphuric acid solution is made by mixing two volumes of glycerin and one of water, and to this mixture, kept cool by surrounding it with cold water, is added with constant stirring three volumes of commercial sulphuric acid.

When a fibre is treated in the manner to be described with these two reagents, it becomes colored either blue or yellow, depending upon the purity of its cellulose. Pure cellulose is colored blue, but when mixed

with matters which frequently accompany vegetable fibres, particularly such as are hard and inelastic, the blue color is concealed by the impurities; and various shades of yellow result.

The strength and suppleness of a fibre depends upon the purity of the cellulose. The yellow color indicates that the fibres are of a woody nature, short, and brittle when bent, although they may be strong in a longitudinal direction. Among the most valuable fibres giving a yellow reaction are the New Zealand flax, *Phormium tenax*, the bowstring hemp, *Sansiviera zeylanica*, and the pita of our southern countries, obtained from some of the agaves, specimens of which can always be obtained from the leaves of the common century plant. Most of the fibres from the palms also give the yellow color.

These reactions afford a ready means of separating fibres into two classes, those which are colored blue and those which are colored yellow. M. Vétillart has made a further division, separating the mono- and dicotyledonous plants, certain ones of each division taking the blue and others the yellow.

To apply the reagents a portion of the dry fibre is placed on a slide, and a few drops of the iodine solution added to it. After a few moments the liquid is removed by the use of blotting-paper, which is caused to absorb as much moisture as possible by pressing it gently upon the fibres.

The cover-glass is then applied, and the sulphuric acid solution allowed to flow under one side while a piece of blotting-paper absorbs it on the opposite side. The characteristic color soon shows, even to the naked eye, and the appearance of the fibres under the microscope is almost sure to lead to their identification.

Among the fibres giving a yellow reaction jute is the most common, and will serve well for experimental trials. Much of the coarse bagging or sacking, burlaps, gunny-cloth, etc.,



contains jute, or is made entirely of that fibre, which also enters into the composition of the cheaper grades of ingrain carpets, matting, twine, and rope.

M. Vétillart has arranged a scheme for the systematic examination of fibres, which gives the distinctive features of the different ones in a very concise form. It is intended to aid the observer in identifying unknown fibres. The arrangement will be translated and published in our next number.

When a typical specimen of any fibre is examined, it is usual to prepare several permanent mounts for the microscope, to be used in comparing different fibres. To be useful such mounts must show the fibres precisely as they appear when examined in water and glycerin. They are therefore mounted in the same mixture. The mounting is very quickly done, and the preparations are permanent.

The slides are first prepared with thin rings of shellac, of the proper size to receive  $\frac{3}{4}$ -inch cover-glasses, and set aside for use as required.

The fibres having been prepared as described above, by boiling in soda, and separated by needles, are then selected for mounting. It is desirable to show all parts of a fibre on each slide. Suppose we have a fibre ten inches in length, and desire to mount it for study. The mount must show both ends of the fibre and different parts along the length. Several such fibres are therefore chosen, placed together in the hand, and pieces cut off from the ends half an inch long. Then at various places along the length other pieces of the same length are cut off and the rest rejected. Thus a good set of specimens for mounting is obtained, which is sure to give all the needed characters—the appearance of the ends, the diameter in different parts, etc. The pieces are placed in the glycerin and water mixture, while the slide to receive them is made ready.

One of the prepared slides is now selected, placed on the turn-table and a coat of thin shellac laid over the hardened ring. Almost immediately a few drops of the mounting medium are placed within the cell, the specimens to be mounted transferred to it, the cover-glass applied, pressed down gently on the fresh shellac, to which it becomes quickly attached. As the excess of liquid is forced out it is absorbed by pieces of blotting paper. The slide is now set aside and others mounted in the same way. In the course of ten minutes the glycerin can be washed away from the surface, under a tap or, as we prefer, by directing a fine stream of water upon it from a chemist's wash-bottle. It is then partly dried with blotting-paper, and in a few moments will be perfectly dry. A ring of shellac is then run around the cover-glass to ensure against leakage, and the slide set aside until a convenient time for finishing it, which may not be for several weeks.

The finishing consists in a coat of asphalt and gold size in equal parts, followed by a ring of asphalt alone.

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### Revivification of Infusoria.

BY JABEZ HOGG.

The mysterious revivification of many of the minuter forms of infusorial life, notably rotifers, or as they are more commonly called, wheel animalcules, cannot fail to surprise and interest those who may for the first time witness their evolution from a few small particles of earth or dust. A drop of water is sufficient to awaken from their longest sleep whole colonies of desiccated rotifers—will in a few minutes restore them to life and vigor and send them on their way rejoicing, just as their ancestors had gone in ages past.

I have previously described a series of observations made under the microscope which seemed to show the indestructibility of those delicately and

exquisitely organized animals, rotifers. To me it appeared that these wonderful infusorial animalcules enjoyed life all the more keenly for being subjected to a prolonged state of suspended animation, for on each occasion of revivification they instantly resumed their functional activity all the more eagerly, and precisely at the point where it was so rudely broken off or interrupted. My experiments, now extending without a break over a third year, have been slightly varied from those of previous years, inasmuch as several members of the Ciliata and Tardigrada families have been included in them, and these have, although not to the same degree, exhibited a remarkable tenacity of life. I have likewise brought the intervals of sleep and vigorous life into strict accord with the durations of dry and wet periods of the year, so that my pets have been kept in a perfectly dry condition during the whole of the long drought which characterized the past summer. Moreover, some older dried specimens were subjected to an artificial process of desiccation. They were kept for a time in a hot-air chamber, the heat in which was raised to 200° F., and subsequently the miniature aquarium in which they were inclosed was plunged into a freezing mixture. Neither process killed them nor greatly diminished their vital powers, their revivification in both cases being somewhat delayed.

Certain toxic agents known to exert a baneful influence over animals standing higher in the scale of life were added to the water supplied to the rotifers, but in no way did they produce discomfort; on the contrary, portions were taken into the stomach and partly digested. On the other hand, a drop of sewage water caused marked discomfort; they immediately retracted their rotating organs and sank down to the bottom of the cell. These were, so far as I can ascertain, poisoned, and this was probably owing to the free sulphide of hydrogen which my nose told me was

being evolved by the putrescent sewage. I lay more stress on this fact because it is said that these and other forms of infusorial life live and thrive in stagnant water. Nothing of the kind: they require a free supply of oxygen, as do other aquatic animals. The wheel-like organs surmounting the elongated body of *Rotifer vulgaris*, and which are seen constantly in motion when the animal is in health, have a treble task assigned to them—that of furnishing a supply of food, renewing the fresh air, and assisting in locomotion. From my observations I am led to infer that rotifers will live and multiply on a very scanty supply of organic matter, provided only that the water is fairly well oxygenated. One other noteworthy change I ought to mention, the greatly diminished or no longer developed eye, due, no doubt, to the withdrawal of the stimulus of light, my rotifers being nearly always kept in the dark. Of the sexes, the females greatly preponderate over males.

In some considerable colonies not a male can be seen. The remarkable power the rotatoria and some few other infusorial families have of resisting, as already pointed out, the extremes of heat, cold, and long-continued drought on desiccation, must excite a desire for a closer acquaintance with these monads, these curious specks of organization.

So far as I can make out, the preservation of the rotifer under ordinary circumstances is due to two especial adaptations. The outer integument or skin, although composed of a firm material, is divided, like a coat of mail, into four or five segments; these are under the control of a set of longitudinal muscles, which, when called into action, enable the little creature to shut itself up, telescopic fashion, and, sinking down, it assumes an ovoid form. As the water in the cell dries up a secreting organ is brought into play, and exuding a gelatinous kind of fluid, covers it with an insoluble envelope, and secures it from



further change. Thus we are furnished with an example of organized matter which for months or years shows no evidence of life; indeed merely possessing a property which, when acted upon by an appropriate agent, gives rise to a series of actions which we recognize as life.—*English Mechanic*, from *London Times*.

### A Solid Watch-Glass.

Our readers have already heard of the solid watch-glass, devised some time ago by Dr. A. C. Mercer, and now favorably known to many investigators as the Syracuse solid watch-glass. The illustration, Fig. 11, re-

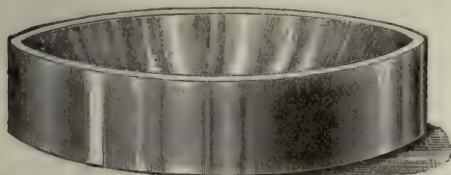


FIG. 11.—The Syracuse Solid Watch-Glass.

presents the glass: It is made of a solid piece of glass, one surface deeply concave and the other slightly so. They are furnished either plain or with surfaces polished, as may be desired. The most desirable form, probably, on account of utility and moderate cost, has upper and lower edges and concave bottom, cut and polished.

The good features of this glass are thus set forth in the circular advertising it:

‘The Syracuse solid watch-glass rests solidly upon the table, or microscope stage, and is not liable to be overturned and its contents spilled.

‘It is transparent and can be used over black, white or colored paper, enabling the student to use such backgrounds to his work as will permit him to watch its progress to best advantage.

‘In it, on the microscope stage, can be examined from time to time, or dissected and studied, transparent tissues while in water, alcohol, oil of

clove, or other bath, enabling the student to reject unsatisfactory specimens at any step in the process of preparation.

‘When the top and bottom edges are cut, one watch-glass rests dust-tight upon another or receives accurately a piece of plate-glass as a cover. In such a watch-glass, covered, specimens may remain for long staining or soaking without becoming dirty and without loss of fluid by evaporation.

‘When the concave surfaces are polished, the watch-glass is as clear as a lens and becomes a perfect receptacle for transparent dissecting material on the microscope stage.’

Having used some of these glasses ourselves, and seen them in use in laboratories, where they have given the utmost satisfaction, we take pleasure in commending them to microscopists. They may be obtained from Dr. Mercer, Syracuse, N. Y.

### Colored Rains.

The following memoranda of colored rains are, presumably, reliable, but we have no clue to the compiler. They are taken from a newspaper clipping, and seem to be records of observed phenomena of some kind. The dates may prove of value to those who have occasion to look up the matter more fully:—

On the 5th and 6th of November, 427 A. D., there was a fall of black dust in the neighborhood of Constantinople, and the atmosphere seemed to be on fire. Marcellus ascribed it to Vesuvius.

Again, in 625 A. D., red dust fell in Constantinople.

At Brixon, in the Austrian Tyrol, in 869 A. D., red rain fell for three hours.

A red sand fell in Bagdad, in 929 A. D., and for many hours previous and subsequently the atmosphere was tinged with red.

In 1056 A. D. there was a fall of red snow in Armenia.

In 1110 A. D., in the province of

Vaspouragan, in Armenia, a flaming body fell into Lake Van, and the water became the color of blood.

In 1219 or 1222 A. D. (the date is uncertain) a red rain fell in Bohemia. At the same time there was a fall of fine sand and a mass like coagulated blood.

On November 6th, 1548 A. D., in Thuringia, a ball of fire fell with great noise, followed by a reddish substance like coagulated blood, which remained covering the ground for a long time.

In Pomerania, in 1557, there fell large flakes of a substance resembling blood.

On December 24th, 1560, at Lillebonne, in Lower Seine, France, a meteor fell, followed by a red rain.

At the close of a terrible tempest, on July 5th, 1582, there fell in Rockhausen, in Prussia, a quantity of fibrous matter resembling human hair.

On December 3d, 1586, there fell in Verden, in Hanover, large quantities of matter, black and red, accompanied by lightning and thunder.

In August, 1618, a meteor fell in Styria, accompanied by a blood-red rain.

In 1638, at Tournay, in Belgium, a red rain fell.

In January\*, 1643, a blood-red rain fell in Voehigen and Weinsberg, in the kingdom of Wurtemberg.

On March 28th, 1663, there fell near Laucha, Prussia, a shower of fibrous substance like blue silk.

On January 31st, 1663, there fell in Norway a great quantity of membranous substances friable and like half-burnt papers. Baron Gotthaus analyzed a portion of the substance, and found in it silex, iron, lime, carbon, magnesia, a trace of chrome and of sulphur, but not a particle of nickel, which is always present in aerolites.

On March 24th, 1718, on the Island of Lathy, in India, a ball of fire fell, and after it a gelatinous red substance.

On October 14th, 1755, a blood-red rain descended at Locarno, Switzerland. Nine inches of rain fell, and

it was ascertained that the red matter contained in this shower was an inch deep by actual measurement. The same storm reached Swabia, on the Alps, and there changed into a reddish snow, which fell to the depth of nine feet.

In March, 1808, at Corniola, Germany, there was a fall of five feet of red snow.

In 1813, according to Von Humboldt, there was a fall of red-colored hail in Palermo.

The same year, according to the same authority, there was a fall of orange-tinted hail in Tuscany.

A brick-colored snow fell in Italy in 1816.

On August 13th, 1819, a mass of gelatinous matter fell in Amherst, Mass.

In 1841 two blood-red rains are mentioned—one in Massachusetts, the other in Tennessee.

In 1843 a man named Ingelow and his sons were picking cotton on a plantation in Laurens district, near Eurole river, South Carolina, when out of an almost cloudless sky great particles of red gelatinous matter fell in a shower.

In 1867 a similar rain fell in Albany, and the late lamented Dr. Jacob T. Mosher, of happy memory, made an analysis of it. He found it contained germs of marine growth, likely *Fucus platycarpus*.

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### Photomicrography at the Health Exhibition.\*

At the same table will be seen a beautiful little aëroscope connected with chronometric clockwork, which causes the rotation of a leading central screw attached to a frame that carries a piece of glass like an ordinary microscope slide, divided by lines into twenty-four hours and one extra. This is smeared with a sterilized viscous material and turned face down, so that when the experiment is begun the extra line corresponds with the

\* From the *Brit. Journ. Phot.*



aperture in the funnel opening beneath. The clock, being allowed to act for an hour, brings the line of the next division into registration at mid-day. The instrument being attached to an aspirator and air-meter, the air is sucked through the funnel, leaving the germs, bacteria, fungi, &c., on the glass as it traverses centrally across the orifice of the funnel at the rate of an hour between each graduation. This is a most useful and ingenious instrument, but rather costly.

There is another of a somewhat similar function, consisting of a bell glass inverted over another with a ledge, which can be filled by vaseline, glycerin, or oil to render the inner space air-tight, whilst a disc divided into separate spaces and covered with a sticky material is made to rotate by a drum clock beneath, so that the divisions are brought opposite to a long slit ground out in the upper part of the bell glass for the air to enter. At the conclusion of the experiment the glass plate is removed and examined by the use of the microscope, though the naked eye can detect differences between the hourly deposits.

There is another small nickel-plated aëroscope attached to an ordinary water aspirator; a portable aspirator, consisting of two large glass jars, for drawing over a moderate but definite quantity of air, and an ordinary water aspirator; also a mercurial one for the drawing over fractional portions of air. Likewise on two pillars at the corners of the table are the modified forms of the Maddox aëroscope, as used at sea and on land. There are different forms of sterilizing apparatus both for hot and cold filtration, and several flasks with readily alterable fluids which have thus been sterilized, and remain perfectly clear. There are some useful little glass culture cells—a modification of Van Tieghem and Lemmonier's cell—and delicate pipettes for infecting the drop-let of sterilized fluid placed on the thin cover glass for microscopical examination under culture.

To the exhibits is added a very valuable list of disinfectants, and such articles as prevent the rejuvenescence of bacteria in readily-putrescible fluid, the biniodide of mercury heading the list; 0.025 of a gramme preventing the putrescence of one litre of neutral beef broth—a thousand times less in weight than what is required of crystallized phenic acid. This list alone suffices to particularize Dr. Miquel's patience and industry. (See *La Semaine Médicale* for 30th August, 1883.) It may be stated that the mildews, which are constant in the air, interfere largely by their rapid growth in the culture chamber if the sterilized liquid be at all acid; hence care is needed to neutralize, or even render slightly alkaline, the liquid in use. Dr. Miquel has raised an important point, much overlooked, as to the death and reviving points in different liquids, and the same liquids at different degrees of density. There are also M. Certes' exhibits of water analysis by coloring the different living organisms.

At the same table are other exhibits, and notably some microscopes by Verrick, and large model microscopes by Nachet, accompanied by a photomicrographic camera. This differs from any we are acquainted with, in that it contains a side tube carrying a prism, used in the examination and placing of the object, and which allows of the prism being withdrawn out of the field prior to exposure, so that a person seated at the side can manipulate the apparatus with ease. The camera is of a fixed length, and carries at the side the focussing rod, connected by a pulley and cord with the fine adjustment. We rather object to the position of the focussing rod, which, like that made by Siebert, we fear may be somewhat in the way.

We must not longer linger over the interesting objects of this exhibit, which we heard a gentleman say was one of those of the greatest interest in the Exhibition, but pass to the table of M. Pasteur—a name too widely

known and appreciated for us to attempt to further eulogize. His valuable contributions to the study of vinegar formation by aërial germs; his work on beer, with studies of the different yeast ferments, and the part they, with other more minute organisms, lay in giving various flavors to beer; his mode of heating wine, (Pasteurizing); his extensive studies on the silkworm disease; his experiments on the cholera of fowls; his efforts to lessen the dire mortality in animals from cattle plague, by the inoculation of a modified form of the virus—all commercially attest to his genius and the value of the microscope. A list is given of the number of animals vaccinated, compiled from the combined labors of his assistants—Chamberland, Roux, Thullier, and others.\*

The above will suffice to induce those interested to examine the various forms of apparatus used in the culture and preparation of sterilized fluids. Among numerous flasks filled with such liquids, notably there stands a large flask—one of historical date—with which he confronted Baron Leibig's theory of fermentation, and showed that the minute living yeast cell was capable of inducing molecular changes in inorganic media. In 1848 he was led, through the discovery of left-hand tartaric acid, to the constitution of racemic acid. There are bottles of the right and left-hand tartaric acids—pasteboard models of the same—'the one, if seen reflected from a mirror, being the image of the other.' In 1858 M. Pasteur found that the right-hand tartaric acid in neutral media will ferment through the action of living ferments, and that these act chiefly on the right-hand acid. There is a phial of tartrate of ammonia, procured from the fermentation of racemate of ammonia, the right-hand salt being decomposed and the left remaining intact. It was sup-

posed by M. Pasteur 'that the molecular dissymmetry of organic substances might have an influence on actions of physiological and vital order,' and was so stated.

There is blood drawn from a healthy rabbit into a sterilized tube, which for years has remained unaltered; also various culture liquids; single and double branched tube-flasks. The doubly-branched tubes admit of the sterilized fluid being infected in one, while the other is kept normal for comparison. There are also a self-closing digester with manumometer for sterilizing liquids; an oven for heating flasks; Schloesing's temperature regulator for water bath, which works by the dilatation of mercury; funnels for the hot filtration of viscous liquids; water-bath and regulator; funnel and water-bath; Moitessier's regulator for gas pressure; D'Arsonval's stove and thermosyphon; D'Arsonval's stove, with constant level and temperature effected by means of the D'Arsonval regulator. This is made by Weisnegg, and admits of very minute estimation of temperature—to the  $\frac{1}{100}$ th of a degree.' Possibly this might be useful, if modified, for gelatine emulsion making. There are other cultivating stoves.

Exhibited also is Pasteur's experimental brewing apparatus without the entrance of air; a gas stove for sterilizing and drying vessels, and hot bath for sterilizing by heat up to 120° C.; a biscuit porcelain filter for filtration in vacuo; a water filter, invented by Dr. Chamberland, for filtering through unglazed porcelain tubes at the normal water pressure. These can be readily removed, cleaned, and even rebaked for use when soiled. We must not omit the historical flasks opened by M. Pasteur at different mountain heights.

There are also various forms of apparatus which have been required for special purposes. There are beautifully-made transfusion and vaccinating instruments; the cautery of Dr. Pasquelin for bloodless operations; a

\* Dr. Thullier unfortunately succumbed to cholera during his study of this epidemic in Egypt; Dr. Roux and Dr. Straus are now occupied at Toulon in the study of this serious malady.



modification of Dr. Roy's, and sliding microtomes; Verrick's microscopes; large and medium stands; lithographs, plain and colored, of the silk-worm moths, caterpillars, internal organs, and figures of the disease corpuscles; figures of many figured ferments found in beer and wine; also drawings of the vinegar process; while adjoining will be seen the mode of examination of silk-worm moths, as carried out on a large scale, with much that is interesting in this fortunately recovered silk-worm rearing, the loss of which would have proved most serious to France; and close to this exhibit is a model apparatus and drawings of the mode of Pasteurizing wine by one of the large wine merchants—M. Houdart. Besides what we have enumerated, there are a few photomicrographs from negatives by Dr. Roux, which have a special claim for notice.

We had the pleasure of examining two small negatives about the size of a sixpence, which bore enlarging up to the ordinary lantern size of transparencies, and to the fidelity of these we can testify. These negatives go far to support what is not generally allowed—that better negatives of bacteria and very minute objects can be produced without the eyepiece, by obtaining more perfect small negatives, than by original large direct negatives. There is, of course, the additional trouble of copying and enlarging; but we must not let this stay our hand when we are seeking for the best work. The plan adopted by Dr. Roux, which is one to meet rapid laboratory work, was to fix a small camera or cell to the eye end of the microscope containing the little gelatino-bromide plate, the position of the focus and the image having been previously determined by placing a piece of plain glass in the slide, and on its upper surface a few scales of moth or butterfly. These are brought into focus by a low-power objective used as a focussing-glass, and the image of the object on the stage of the micro-

scope and the image of the scales are made to coincide. Hence, by withdrawing the little camera and inserting the focussing objective, the focus of any object on the stage can be made to occupy the exact position of the scales on the transparent glass. In other words, the focus of these and the new image are coincident, and, the surface of the small gelatino-bromide plate falling exactly on to the same plane, there can be no error through the different thickness of the glass plate, as the focus of the scales, the image of the object, and the sensitized surface are in one plane.

The illumination is by a small paraffine lamp. The arrangement is simply removal of the eyepiece, insertion of the focussing objective, and then the fixing the little camera into position. There is no reason why a somewhat larger camera may not be used, and a rather longer and larger tube adapted to the working microscope, or the camera may be in part supported, as suggested by Dr. A. C. Mercer, of Brooklyn, U. S., by a strut from the stand of the microscope. For the most perfect work it would, perhaps, be preferable that the camera should be only loosely connected with the eye end of the microscope, though otherwise a fixture. The plan of development adopted by Dr. Roux was that, we believe, recommended by Colonel Stuart Wortley, of soaking the plate in weak ammonia before applying the pyro., and then adding ammonia, as required, to bring up the image. We would strongly recommend examination of these exhibits, and we must again remind those disposed to aid photographically in the study of the bacteria, that patience—the common virtue of the photographer of the infantile world—will be largely requisitioned, even under favorable circumstances.

There are other photomicrographs in the gallery of the Albert Hall; and in Dr. Cheyne's laboratory will be seen some of Dr. Koch's photomicro-

graphs of the bacteria of disease, and a Siebert's camera; but we must not further particularize.

## EDITORIAL.

**Publisher's Notices.**—All communications, remittances, exchanges, etc., should be addressed to the Editor, P. O. Box 630, Washington, D. C.

Remittances should be made by postal notes, money orders, or by money sent in registered letters. Drafts should be made payable in Washington, New York, Boston, or Philadelphia.

Subscription-price before April 1st, \$1 per year, in advance. All subscriptions begin with the January number. After April 1st the subscription-price will be \$1.50.

The regular receipt of the JOURNAL, which is issued on the 15th of each month, will be an acknowledgment of payment.

The first volume, 1880, is entirely out of print. The succeeding volumes will be sent by the publisher for the prices given below, which are net.

Vol. II (1881) complete, \$1.50.

Vol. III (1882) complete, \$2.00.

Vol. IV (1883) complete, \$1.50.

Vol. V (1884) complete, \$1.50.

Vol. V (1884), Nos. 2-12, \$1.00.

## BEADING OF AMPHIPLEURA.—

Doubtless many of our readers, especially those who read foreign journals, have of late heard more or less about the beaded structure of *A. pellucida*. Dr. Van Heurck has been trying to photograph the beads, which he claims to see, but with only indifferent success. Not much has been said in these columns about the matter, for the reason that we have not been quite prepared to accept all that has been said about the visible beading on the frustules.

It was our good fortune to have the pleasure of meeting Prof. Hamilton Smith during our recent visit to New York. We happened to meet in Mr. Woolman's store, where there was an opportunity for a few words about microscopy in general and his own recent work in particular. Prof. Smith freely expressed his doubts as to the reality of any beaded structure of the *A. pellucida* which he had seen. Being well acquainted with the Spencers, whose objectives he regards as equal to any in the world, and having the assistance of their skill in manipulation, being also, as we all know, himself a skilful operator, it would seem scarcely credible that a true beaded structure

could escape their united efforts to discover it.

We hope to give a summary of Dr. Van Heurck's observations before long. When his photographs are published microscopists will be able to form an opinion of what he has observed. At present their attitude must be one of doubt concerning the reality of the appearance. Prof. Hamilton Smith asserts that he can at any time show a beaded appearance, which is purely an illusion, and is visible even with a  $\frac{1}{4}$ -inch objective. The diatoms coated with silver, prepared by Dr. A. Y. Moore, which Dr. Van Heurck has used, have failed to show any peculiarity of marking in the hands of other competent observers. We look with great interest to the forthcoming photographs.

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**POSTAL CLUB BOXES.**—Box D<sup>2</sup> reached us December 16th, with the following preparations:—

1. Internal organs of beetle. Dr. W. W. Munson. Preparation made by S. N. Cowles.

2. Frond of fern showing sporangia, etc. E. L. Cheeseman.

3. Transverse section of stomach of frog. G. W. Worcester. Stained with eosin. Evenly cut but rather thick section.

4. Child's kidney, stained section. C. K. Wells. Not a very even section, but some parts show well.

5. Vertical section of tea-leaf. Fred. T. Aschman. A very interesting section; but its points of special interest should have been mentioned in the letter accompanying the box.

6. Transverse section of cat's tongue, injected. A. T. Veeder. This is the most attractive specimen of all to look at under the microscope, although not very neatly mounted.

Not one of the preparations in this box are described, and they do not possess the interest to the club they might otherwise have. We trust that as new slides are put in the boxes this year there will be a general im-



provement in this respect. We also hope there will be more preparations of real merit, which show care in selection and mounting. There are still a few slides in the circuits which we strongly suspect to be carefully selected from discarded or inferior lots. The club is worthy of one's best work on at least a single slide, every year.

Box CC, one of Cole's 'Studies,' was received in this circuit January 10th.

Box 28 came into this circuit January 19th, containing six preparations by Dr. T. B. Redding.

1. Alveolar sarcoma. Some doubt being expressed as to the true character of this growth, Dr. G. N. Krüder verifies the diagnosis, 'sarcoma is round-celled variety.' A drawing in color, with brief description and letters of reference, show the special characters of the preparation.

2. Transverse section through centre of foot of human foetus.

3. Transverse section through posterior part of human tongue.

4. Human larynx and œsophagus, from foetus.

5. Section of heel of human foetus.

6. Preparation of human stomach.

These sections are all well cut, stained, injected, and mounted, and must prove of interest to histologists and others.

Box C<sup>2</sup> reached our circuit February 3d. It contained the following preparations:—

1. Diatoms covered with pyrites. H. Carvill Lewis. No further account of these diatoms is given, but it may be assumed they are from the deposit known as the London clay. The preparation would be none the less instructive were it less roughly mounted. Mr. A. C. Cole has mounted some fine specimens of these diatoms. Certain persons in England, not being able to obtain good specimens, started the novel idea that Mr. Cole had electro-plated them!

2. Dust from the Krakatoa erup-

tion. H. C. Lewis. Collected on the barque 'William H. Blase.' The reader may refer to p. 101, Vol. V, for an account of the peculiarities of volcanic dust. The specimen is an excellent one for study.

3. This is marked 'Pollinia of?' It is from Mr. W. H. Walmsley, who seems to have been in a terrible hurry when he put it in.

4. Sections of sassafras wood. E. Pennock.

5. *Comatricha longa*. Geo. A. Rex. The thready skeleton of a myxomycetous fungus. A very interesting specimen. Owing to defect in the mounting, the following note is attached:—

'This object has been remounted by the Curator of the club's cabinet in a cell made of wax, covered with gold-size. The Curator would suggest to those who have not had much experience in mounting, that in order to make a fluid mount secure it is necessary to see that the top of the cell is perfectly even, so as to insure complete contact between the cover and cell all around. In the present mount the cell was made of a wax ring covered with gold-size, and allowed to become hard. The cell was then lightly ground on a piece of fine emery paper attached to an even surface of wood until it was perfectly level. At the time of mounting, the edge of the cell was lightly covered with gold-size, and the mounting medium and specimen placed within. The edge of the cover was then touched with cement and carefully placed in position. Pressure was then made at the edges of the cover only until complete contact was secured. The superfluous glycerin was then washed away and a ring of cement run over the edge of cover and cell to the surface of the slide.'

No doubt the mount is now a permanent one. The process may do well enough for persons who have time for it. Others had better use the shellac method described several times in these columns. A mount

can be secured in ten minutes one evening, finished in less time the next, and be absolutely secure.

6. *Aphanomyces phycophilus*. Dr. L. Brewer Hall. A fungus penetrating and destroying a fresh-water alga, *Spirogyra crassa*. Found in 1883 in a pond in Fairmount Park, Philadelphia. A good specimen for study.

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A NEW JOURNAL.—The first number of the *Journ. New York Micr. Soc.* has reached us. It is a very neat pamphlet, which should receive liberal support from microscopists. It is edited by Mr. Benjamin Braman. The business address is Station E, New York City. We bespeak for this new periodical a cordial reception wherever it becomes known. It contains two articles in addition to the proceedings of the meetings of October, November and December, and an 'index of articles of interest to microscopists which have recently appeared in other journals.'

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POLLEN TUBES.—Our remarks in the December number of the *JOURNAL* have received some attention from the Editor of the *Botanical Gazette*, who seems, however, disposed to criticise our remarks, rather than the hypothesis of which we wrote. 'The purpose of our few words was, obviously, to draw attention to the subject, and in this we have to some extent succeeded. Having always disclaimed any special knowledge concerning this subject, we are not particularly hurt by the allusions to our 'lack of information concerning botanical laboratories and methods of to-day.' It is just possible, however, that we are somewhat acquainted with the facts concerning botanical laboratories, and the work done in them. If not, is it not partly the fault of the Editor of the *Gazette*, of which we have long been a constant reader?

In spite of the boldness with which we are berated for our ignorance in

this matter, we still think the facts are in our favor. The amount of scientific investigation in botanical histology that is being conducted in this country is not very great, and we have not a wonderful array of well-equipped botanical laboratories either. It is not our custom to make assertions in these columns that are not sustained by facts of which we are cognizant.

It should be observed that the fact of fertilization by the extension of the pollen tubes into the ovary has not been questioned by Mr. Kruttschnitt, so far as we recollect, certainly not by ourselves. The question is simply narrowed down to whether the process of fertilization takes place as described by Mr. Kruttschnitt in the plants which he has studied. It is unjust, therefore, to infer that that gentleman has undertaken to prove 'the descent of the pollen tube to the ovule is a myth.'

There is no reason why we should champion the work of Mr. Kruttschnitt, and we do not propose to do so. It must stand or fall upon its own merits. But our sympathies and interest have been drawn into it because we have seen the same spirit manifested in this case as has been obstructive to the progress of knowledge in every age—a spirit which the world will doubtless eventually outgrow, but which still lives in this century in full vigor. It is the same spirit which asked, so long ago, 'Can any good come out of Nazareth?'

Our critic asks, what notice a chemist would give to one denying that hydrogen and oxygen exist in water? The question is not pertinent. In this case we have the results of careful investigation. As such they are entitled to recognition. To us—although this is of no consequence in the discussion—they have seemed to bear out the hypothesis advanced. There are some arguments based upon them which seem very strong. They are enough to deserve attention, and to encourage further



research in order to settle the question. We are told that valuable work is appreciated by every botanist. Doubtless it is, but doubtless also a long time is required for botanists, as for other scientific persons, to learn just what is valuable.

A correspondent, who has given some attention to this subject, instances the common Indian corn, *Stramonium*, and other plants having very long styles, and says 'imagine the length of a pollen tube needed to reach the ovary!'

We would like to know what our critic would have us infer from the concluding sentence of his article? If he means that in Mr. Kruttschnitt's preparations he found pollen tubes in the ovaries, then he need only say so to settle the question. If he did not find them there it is unjust not to say so. If they are not there can he tell us why they are not there? We trust something more than the very non-committal verdict of 'not proven' has resulted from his observations.

Since this article was written a criticism of Mr. Kruttschnitt's papers by Mr. N. L. Britton has appeared in the *Journ. N. Y. Micr. Soc.* We commend this article to all who are interested in the subject, as an excellent review of the bibliography concerning it. We cannot believe, however, in spite of the great array of authorities, and the rather intolerant spirit of the author regarding Mr. Kruttschnitt's conclusions, that the field has been thoroughly explored. As suggested some time ago, we would like to know the different stages through which the process of fertilization has passed before it attained the perfection now observed in many plants. Is it not still possible that we shall find plants in which the fertilization is effected in a more primitive manner? Or, on the other hand, may it not be possible that a still higher organization will make pollen tubes unnecessary, and lead to their abortion in the plant? If these questions are speculative, they are

still reasonable, and worthy of some thought, as could easily be shown did not our limited space preclude more extended discussion of the subject.

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THE GENERA OF ALGÆ.—A series of articles will be published this year, written by the Editor, entitled 'Key to the Genera of Fresh-water Algæ,' which, it is hoped, will prove of service to those who wish to study that interesting class of plants. The system of classification adopted is essentially that of O. Kirchner, although the arrangement of the genera corresponds to that of most older works, and follows closely that of Rabenhorst, and the later publication of Cooke, 'British Fresh-water Algæ.' Kirchner begins with the higher forms and leads down to the simpler ones. We have preferred to follow the other plan, which begins with the simplest and leads up to the more complex forms.

It is probable that during the present year the demands upon our time will prevent the regular publication of these articles. We can hardly expect to prepare one each month; for the work must be done very carefully if it is to be valuable for the purpose intended. We can only promise to do what time permits, and trust that our readers will find the articles of value. It is intended to represent most of the genera described by outline sketches.

—O—

AMONG THE DEALERS.—During the holidays we had occasion to visit Philadelphia and New York, which afforded an opportunity to call upon some of the well-known dealers, and to look over the new products of their factories. We first called upon Mr. Walmsley, who was busy enough with his holiday orders. He has one of the most attractive places on Chestnut street, and evidently does a large business in microscopes and photographic apparatus. Unfortunately, we are not quite at liberty to

mention some of the forthcoming announcements concerning the R. and J. Beck optical goods, but before long our readers will hear something to their advantage. Mr. Walmsley is agent for the Kingston photograph plates, made in England, which are to be highly recommended for microscopical photography, as well as for other purposes.

At Mr. Zentmayer's we found an article which should have a large sale. It is an Abbe condenser, mounted so that it can be fitted to almost any stand with a sub-stage, with a convenient and ingenious fitting for the diaphragms. This is undoubtedly the most convenient form of the Abbe condenser yet devised. It is thoroughly practical, and only costs \$22.00. The new turn-table, described last year, has been in good demand, and the 'histological' stand is still as popular as ever.

Mr. William Wales has been busy enough, although trade is not very brisk with any of the opticians. He has lately made some half-inch objectives with an angular aperture of  $50^\circ$ , which have been highly spoken of and with which he is well pleased himself. One which he had on hand was most excellent. We saw with it some discoid diatoms, some muscular fibres and the podura-scale, but Mr. Wales significantly remarked, 'this lens will not resolve *Pleurosigma angulatum*.'

Mr. Emmerich says that trade in the objectives and apparatus of Zeiss has been very good during the past year, and he expects it to increase. We have already alluded to some preparations he offers for sale, but it may be added that he will also have some preparations of the tissues of the young salamander, which are prepared to show the various histological elements, elementary tissues, cells, etc., making a valuable series for study.

Mr. Woolman had a good supply of apparatus of different makers, and as he is not devoting his interests to

any one make of goods, he is sure to have something of interest at all times.

Mr. J. Grunow is making some fine objectives of the oil-immersion type, which have been very highly spoken of. He makes now a  $\frac{1}{8}$ , a  $\frac{1}{10}$  and a  $\frac{1}{12}$  oil-immersion. A  $\frac{1}{4}$  dry which he has recently produced appears to be a very excellent objective for general use. Its definition is sharp with a  $\frac{1}{2}$ -inch solid ocular, giving about 1300 diameters. The angular aperture of this lens is  $165^\circ$ ; the price is \$40.00. Mr. Grunow also makes an Abbe condenser, with either two or three lenses, which is very well mounted. Some new stands by Mr. Grunow are also excellent in design and construction. Mr. Grunow's work seems to be better known among medical men than among the microscopists throughout the country, but this is not due to its want of merit, but rather to the fact that his long-established business has led his trade in a certain direction. His improved camera lucida, Abbe condenser, oil-immersion objectives and well-designed stands, prove that he is well able to meet the most exacting demands of the time.

One of the last places we visited was the New York office of the Bausch and Lomb Optical Company. For a notice of the various fine stands and ingenious accessories they offer, we cannot do better than refer the reader to their well-illustrated catalogue. We went especially to see the electric light which they have applied to the microscope. The result was in every way satisfactory so far as the general character of the light is concerned. A very small lamp was used and a brilliant illumination was the result, far superior to lamp-light of any kind, and more manageable. The battery was objectionable. We shall have something more to say upon this subject next month, as our space is now too fully occupied.

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EXAMINATION OF DRIED ALGÆ.—  
It has long been known that by treat-



ing the dessicated specimens of algæ, such as are preserved on paper in the herbarium, with a solution of caustic potash, the cells resume their original size and shape, so that they may be studied microscopically. Any medium that will restore the forms of the cells adds greatly to the interest and value of such a collection, for the wrinkled, misshapen filaments one sees when water alone is used are far from attractive to the eye. Mr. G. Lagerheim has prepared a fluid for this purpose, which possesses some features worthy of note. It is composed of water 5 parts, in which is dissolved 1 part of fused potassic hydrate, and 5.5 parts of strong glycerin added. To examine dry desmids, cædogoniums or other algæ the specimen is moistened with water, transferred to a slide and a drop or two of the solution added. After spreading the algæ in the fluid it is heated gently over a flame. The algæ then swell and resume their natural form.

To mount the specimens, particular species may be easily selected under a low-power objective and removed to a solution of potassic acetate or glycerin. Should it be desired to mount the entire specimen under examination a little acetic acid may be added to the mixture, which will produce potassic acetate by combining with the potash, and the preparation sealed.

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**QUANTITATIVE ESTIMATION OF MICRO-ORGANISMS IN THE AIR.**—A convenient method of determining the relative number of organisms in the air in different places and at different seasons is very desirable. Various methods have been described from time to time, in most of which a current of air is directed against a surface coated with glycerin, in which the germs or spores are caught and submitted to microscopical examination.

These methods have served very well, but it has always seemed to us a

very unsatisfactory means when the character of the spores was an important question, for the reason that it is not usually possible to distinguish spores generically or specifically by their appearance. Other methods have been in use in which the spores are collected in nutritive media in which they are cultivated. The latest form of apparatus for collecting spores for cultivation is that of W. Hesse. This consists of a long glass tube—about 70 cm. in length and 3.5 cm. wide, covered on the inside with sterilized gelatin. Through this tube a current of air is drawn at a regulated speed, and the volume that flows through is measured. The spores are deposited on the gelatin, and after a sufficient time they germinate and form colonies on the gelatin which become visible to the naked eye.

The relative number of spores in the air at any time can be estimated by counting the number of centres of growth. Each kind of growth can be isolated and cultivated by itself.

Having obtained the colonies in the tube, the organisms may be killed by passing sulphurous acid gas through it, and the appearance of the growing colonies thus preserved as a record for future comparisons.

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## NOTES.

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—The first number of the *Journal of Mycology* has reached us, and we are pleased to welcome it among our exchanges. It is devoted to mycological botany, special attention being given to descriptions of North American species of fungi. It is edited by W. A. Kellermann, Ph. D., assisted by J. B. Ellis and B. M. Everhart, and published at Manhattan, Kansas. It promises to be a valuable scientific publication, and we trust it will receive ample support.

—One of the most successful operators in photo-micrography is Mr. Walmsley, who is continually adding to his store of fine negatives of microscopic objects. We would not like to say he photographs all the good specimens that pass through the postal-club circuits, but he certainly pre-

serves a record of some of them in that way. One of his latest productions is from a slide contributed to one of the boxes by ourselves, a hydroid zoophyte with extended tentacles, *Halecium halecium*. The cilia are plainly suggested by the photograph, although certainly not visible—probably not in the preparation itself. Among other good photographs, all taken with Beck's lenses, are the eye of a drone fly and a transverse section of a nerve.

—The best stage-micrometer we have seen has recently been made by Prof. W. A. Rogers for the National Museum. It is not better in ruling than others from the same source, but its peculiar excellence is due to the fact that it is mounted in Prof. Hamilton Smith's new medium of high refractive power. The result is, that the fine lines are far more visible and sharp than on ordinary micrometers. Very fine lines, which are scarcely visible otherwise, are readily seen when mounted in the new medium.

—Messrs. H. R. Spencer & Co. have issued a neat price-list of objectives made by them. They guarantee their objectives to be strictly as represented, and no goods will be sent on approval. This is good business policy for those who are sure their goods will satisfy purchasers. It shows a determination to send out first-class work. They offer also some cheap but well-made microscope stands, varying in price, with objectives, from \$42.00 to \$83.00.

—An excellent method of studying the minute forms of pond-life has been several times mentioned in these columns, both editorially and by correspondents who have adopted it. This is by suspending glass slips in ponds until they are covered with vegetation and infusoria. It is called to mind once more by the investigations of algæ by L. Kny. He suspends a slip of glass in a cylinder of water and allows it to remain until covered with the growths he desired to study. The plan has much to recommend it, as the organisms can be studied without disturbing or removing them from the sub-strata on which they grow.

—The medium of high refractive index discovered by Prof. Hamilton Smith, and mentioned from time to time in these columns, has engaged his attention for a long time. He now believes it can be made perfectly permanent. Heretofore it has become cloudy after a time, and specimens mounted in it spoiled. The com-

position has not been made public, for good reasons, although it is not a secret with himself alone, being known to several persons. It will be made known in due time. The experiments made by Prof. Smith in the course of his work to find very highly refractive media have led to the discovery of several preparations of this character, which may yet be used with great advantage. They are easily prepared, and are sure to be employed when the method of making them is published.

—In *Dental Cosmos*, November, 1884, Dr. J. L. Williams has an interesting and valuable article 'On Certain Disputed Points in the Development and Histology of the Teeth.' It is illustrated by woodcuts and two heliotype plates. The subject is rather too technical to be noticed at length without giving more space than can be spared in these columns. Dr. Williams, it will be remembered, has prepared some fine sections of teeth by the method described in vol. v, p. 142.

—Some time ago a gentleman in Paris purchased a one-inch objective of very wide angle of American manufacture, and as it may be of interest to know the estimate put upon it in Paris we quote a few words from a private letter recently received. 'After careful examination and showing it to friends, we do not find that it has any advantage over a Nachet, which he supplies for 25 francs, (\$5.00). There is more light, a point of very little importance in so low a power, it has not any greater defining power on test plates, but its great defect is want of applanatism—the edges of objects are dreadfully distorted.'

—Mr. H. G. A. Wright recently described a preparation of the proboscis of a blow-fly mounted without pressure in a solution of biniodide of mercury in iodide of potassium, which was said to reveal details of structure in the pseudo-trachea not hitherto observed. Without entering into particulars, we draw attention to the fact, which suggests a more extended use for this highly refractive medium.

—Mr. A. D. Michael has described a new acarus of the genus *Myobia*, which was found on bats, particularly the *Rhinolophus hipposideros*. The description is published, with plate, in the *Jour. Quekett Micr. Club*, Ser. 2, vol. ii, p. 1.

—A gentleman in Europe, who has recently obtained a  $\frac{1}{4}$  homogeneous immersion by H. R. Spencer & Co., writes



to us as follows: 'It is the finest glass I ever saw, beats Powell's  $\frac{1}{10}$  quite away—is the admiration of everyone.'

## CORRESPONDENCE.

### White Zinc Cement.

TO THE EDITOR:—I have been an interested reader of all that has appeared in the JOURNAL, both pro and con, concerning the use of white zinc as a cement in dry mounts. And I mail to you herewith four slides of dry mounts which, with the two previously sent, please add to your collection, with a view to testing the reliability of the cement. In common with many preparers, I have been disgusted with the amount of trash in circulation as exchanges, and have not always found the work of even professional preparers infallible as to running in. So, when I commenced mounting, I was the more determined that none but first-class, durable work should leave my hands. White zinc was the cement I selected for dry mounts of diatoms, etc., and I have never had occasion to regret my choice. My experience has been that white zinc cement properly prepared, not the work of a tyro, the rings to be made at least 48 hours, and preferably several weeks in advance, will not run in. I shall regard it as a favor if any person who has received any of my slides, either by purchase or exchange, which have not kept well will return such slides, and I will cheerfully replace them with perfect slides.

M. A. BOOTH.

LONGMEADOW, Mass.

[It would afford us great pleasure to testify to the excellence of the preparations kindly sent by our correspondent could we do so conscientiously. Unfortunately they are all defective, and the specimens are already ruined. The white zinc cement has been unable to withstand the conditions incident to travel. Every slide was literally smashed to pieces, so that the glass was almost powdered.

As regards the different experiences of workers with this cement, however, there is this much to be said: That if one has time enough to wait for a cement to harden thoroughly any of the cements in common use will undoubtedly serve perfectly well. We have no more doubt of the possibility of making durable mounts with white zinc cement than we have that they could also be made with gold-size, which eventually would dry hard and never run in. It is purely a matter of

time in this case. The point we have urged against the use of white zinc is not that it is impossible to use it successfully, but that, as experience has shown, in the hands of a considerable number of workers it is unreliable. Contrary to the opinion of a somewhat discursive critic, our opinions upon this matter are not based upon what we have done so much as upon what we have seen of the works of others; so that we have discarded it for our own use. The trouble is that we—like many other workers—must work rapidly, and a cement that hardens slowly will not do. Thus, on Christmas day we found a specimen of such interest that we wished to send a mounted preparation abroad. By the use of shellac, on a perfectly plain slide, a ring was made, the specimen mounted within it in water, and sealed up within ten minutes, and had we not wished to put a ring of black varnish on it the preparation could have been safely mailed the same evening, and we could guarantee it against running in or leakage. Quick and sure work like this is impossible with the white zinc cement.—ED.]

—o—

### Mounting Urinary Deposits.

TO THE EDITOR:—In response to the inquiry of your correspondent, in the December number of the JOURNAL, I offer the following formula for a mounting fluid for urinary deposits: Glycerin and distilled water each four fluid drachms, chloral hydrate five grains, creosote five drops, gum camphor two grains. Mix, shake thoroughly, and filter.

As far as I have tried this, it preserves epithelium, casts, and to a limited extent crystals.

To prepare casts, place the urine in a conical vessel, and when the sediment is well settled remove the supernatant fluid with a syphon, dilute the sediment with distilled water, let settle, and again remove the supernatant fluid as before, and repeat as often as is necessary. When the sediment containing the casts is sufficiently clean, add to it a few drops of carmine solution, let stand five or ten minutes, again dilute with an equal amount of distilled water, and remove the supernatant fluid down to the sediment. Now add of the mounting fluid above named a quantity equal to that of the sediment, and mount in cells made by running rings of asphaltum on clean slides. If used within half an hour any irregularities of their surfaces will yield when the

cover is pressed down, requiring no further leveling. Place two drops of the mixture in a cell so that it may be a little more than full when the cover is applied to avoid air bubbles, ring with white zinc, first tacking the edges of the cover to avoid moving it with the brush.

A. G. FIELD.

#### Pteratomus Phaseolus.

TO THE EDITOR:—In the month of October last, while examining the pollen of flowering bean (*Phaseolus multiflorus*), I discovered a hymenopterous insect which appeared to be feeding upon the pollen grains. As far as I can discover, this is hitherto undescribed. It belongs to the genus *Pteratomus*. I propose for it the name of *Pteratomus phaseolus*, and submit the following description:

Order Hymenoptera. Family Proctotrupii, Lat.

*Pteratomus phaseolus*, n. s.?

♂♀ Total length  $\frac{1}{10}$ -inch, breadth  $\frac{1}{8}$  of length. Antennæ 6-jointed. The 5 basal joints each armed with a short spine. Joints similar except terminal, which swells slightly before tapering to point. Head and thorax armed with a few stiff spines. Abdomen about 3 times length of thorax, about same breadth, with stiff hairs from each segment. Clearly divided into seven segments of about equal length, except anterior, which is about one and one-half times the length of the others, having two rows of spines. Legs armed with a spine on last joint. Wings transparent, fringed, and covered with minute hairs. Color uniformly ochreous brown. Eyes large and black. The anal claspers of male very large, much serrated. Habitat—flower of bean. Larval stages unknown. October.

JNO. B. BETTS.

CAMDEN, N. J.

#### Photo-Micrography.

TO THE EDITOR:—I have become quite interested in the subject of photo-microscopy; but I know nothing of the relative value of the various instruments on the market. I should be glad to see in your paper a review of the different apparatus. I think this would come in very opportune, as there are to be papers on photographic methods.

[We shall have something to say upon this subject before long, if we are not anticipated by some contributor who will favor us with his experience. It is a sub-

ject of growing importance; and we would be glad to receive an article upon the apparatus offered by various makers.—ED.]

#### Spongilla.

TO THE EDITOR:—That fresh-water sponge mount now on its travels in the postal club boxes, which you kindly noticed, was labeled *Spongilla*, not to indicate the genus, but simply because the term, by common consent, means a fresh-water sponge. As it may interest those who have seen the mount, and those who will see it, to know the correct name, I would like to say it is *Heteromeyenya Rideri*, it having been determined by Edward Potts, the able specialist.

S. LOCKWOOD.

December 20th, 1884.

### NOTICES OF BOOKS.

*Ceratiocaridæ from the Chemung and Waverly Groups at Warren, Pennsylvania.* By Chas. E. Beecher. With two plates. Harrisburg: Lane S. Hart, Printer. 1884. (Pamphlet, pp. 24.)

*The Fresh-Water Flora and Fauna of Central Park.* Preliminary paper, with bibliography. By L. P. Gratacap and A. Woodward. New York: Macgowan & Slipper, Printers. 1884. (Pamphlet, pp. 19.)

This is a useful, although, being a preliminary paper, not by any means a complete, record of the fauna and flora of the lakes in Central Park, New York. A list of organisms found is given, and a 'Contribution to the bibliography of fresh-water flora and fauna of the United States, mostly microscopical,' which covers several pages. Doubtless the pamphlet can be obtained by addressing Mr. Woodward, at the Museum of Natural History, New York City.

### Exchanges.

[Exchanges are inserted in this column without charge. They will be strictly limited to mounted objects, and material for mounting.]

Exchanges by list of all kinds of first-class material for mounting solicited.  
A. M. BOOTH,  
Longmeadow, Mass.

Unmounted material and labels for slides in exchange for good slides.

EUGENE PINCKNEY,  
Dixon, Ill.

Fossil Diatomaceous Earth, (a new find), very interesting forms for other material.

J. WALKER,  
870 Twelfth Ave., South Minneapolis, Minn.



# THE AMERICAN

## MONTHLY

# MICROSCOPICAL JOURNAL.

VOL. VI.

WASHINGTON, D. C., MARCH, 1885.

No. 3.

### Staining Tissues for Photography.

BY GEORGE A. PIERSOL, M. D.

Satisfactory results in photographing histological tissues depend largely upon two conditions:—

1. Having a section so thin and even that little more than a single layer of cells is included;

2. Having such thin section properly stained—especially sufficiently differentiated.

Regarding the first condition, but little difficulty is experienced in these days of sliding microtomes, whose advent has marked a new era in section cutting.

The successful completion of the second condition for photography, is not always as readily accomplished. By most workers, probably, the stains ordinarily employed and valued for general use are borax-carmin and hematoxylin; of the two, the latter is usually the more highly prized—the simple manipulations required and the unsurpassed results justly giving hematoxylin a recognized pre-eminence.

These sections stained with borax-carmin (properly used) yield often excellent negatives; in their strata the red color being sufficiently non-actinic to give a vigorous contrast on the plate. In well differentiated carmin staining, however, little else than cells is colored, and frequently delicate details of the connective-tissues are wanting on account of their transparency.

Hematoxylin stainings, in very thin sections, while all that can be desired under the microscope, are usually very disappointing when photographed;

the delicate layer of tissue offers almost no actinic contrast when monochromatic sun-light is obtained by the ammonio-sulphate of copper cell.

Since hematoxylin is so extensively employed in all lines of work, a ready modification of this staining to meet the needs of photography is of advantage. Such a result is obtained by a modified use of a formula of Wiegert, already commended to the readers of the JOURNAL by Dr. Councilman\* for the study of the brain and spinal cord. While especially intended for nervous tissues, the modified use furnishes specimens of all organs admirably adapted for photography.

No especial formula for hematoxylin is needed, using one which is capable of staining deeply and giving standard results. In the usual course of work the sections are stained; a few very thin ones, however, are allowed to remain in the solution, after those for ordinary preparation, until they are of an intense dark purple, when they are transferred, one by one, to a capsule containing a solution composed of the following constituents:—

Borax.....	1.
Potassium ferricyanide.....	2.5
Water.....	100.

In this they are kept moving until the intense color is gradually discharged, and the purple tint is replaced by a bronze-yellow, shading to saffron. Before the sections reach the latter color they should be washed in water; the further usual steps in mounting are then completed.

\* The Microscopic Investigation of the Brain and Spinal Cord, vol. v, p. 201.

Sections so stained, and mounted in balsam, will be found to possess all the differentiation given by hematoxylin, with a change from the purplish blue color to the subdued tones of brown—a substitution often most pleasing and grateful to the eye.

While in general appearance these sections resemble successful Bismarck brown staining, there are differences in color, the modified hematoxylin possessing a peculiar grayish brown tint, in addition, the differentiation being better marked, and much more readily obtained than with the Bismarck brown, which is sometimes rebellious.

For photography, these modified stainings are well adapted, since the thinnest possible layers are sufficiently non-actinic to yield a vigorous picture. A comparison of the results obtained from delicate sections stained with carmine or hematoxylin, as usually employed, and ones colored as suggested, will convince that in the modified hematoxylin we possess a really useful and very convenient method of preparing tissues for photography.

—o—

### Beading of *Amphipleura* and Photo-Micrography.

BY THE EDITOR.

Dr. Henri Van Heurck, who has been investigating the structure of the frustules of *Amphipleura pellucida* with great care, with the best objectives, has favored us with a photograph showing a portion of a valve resolved into dots. It was made with a  $\frac{1}{8}$ -inch homogeneous objective of Zeiss; the illumination was with an incandescent electric lamp and vertical illuminator; amplification 3,000 diameters.

The print shows what may be called a beaded structure clearly enough, although as a whole the picture lacks the sharp definition which is seen in the excellent prints made by Dr. Woodward. This, however, is probably a natural consequence of the method of illumina-

tion employed. The median line seems not to be in focus, and the margin of the valve on one side—the side on which the markings are seen—is very irregular and ill-defined. The portion of the valve on the other side of the median line is almost wholly lost. A small portion only, probably what was in the middle of the field of view, shows the markings.

It can scarcely be expected that a photograph of such a difficult object—so extremely difficult to resolve that the markings have escaped the closest scrutiny of many competent observers who have sought to find them—should be sharp and entirely satisfactory. The appearance actually presented is of a series of longitudinal lines crossed at right angles by transverse lines. Closer examination shows an approach to a dotted structure, such as one observes in other diatoms with coarser markings just before they are perfectly resolved into dots. The two systems of lines are clearly seen, however, and the only question that can now be raised against the conclusions of Dr. Van Heurck, is whether the structure represented in the photograph is real, or a result of diffraction caused by the particular method of illumination. This question can only be answered by actual work with the microscope, and even then it may not be easily decided.

Accompanying the photograph was a letter from Dr. Van Heurck, which we have translated and now publish below. It contains information concerning photographic work with the microscope that is of great interest.

Dr. Van Heurck writes as follows: 'The print I send you was made from a preparation of silvered diatoms similar to those which Dr. Moore sent to the Royal Microscopical Society of London. I do not know what process Dr. Moore employed, but my method of silvering is simple and easy. It gives perfect results and always the same. I give the process in the "Synopsis of Diatoms." I



have already used it a number of years for silvering prisms and other articles for my scientific researches.

'The preparations being opaque, I naturally have employed the vertical illuminator for lighting them. The photograph was made with a  $\frac{1}{8}$ -inch homogeneous objective of Zeiss, with a magnification of 1,000 diameters, and the picture afterward enlarged to 3,000, which is not too much for the most delicate details.

'The photograph is very difficult to obtain, first because in the light employed the valve appears green and the details are shown with difficulty; secondly, because details so fine disappear with the slightest movement of the apparatus.

'The first proofs, obtained with a large microscope of Messrs. Powell & Lealand, which is however a model of admirable precision, were very defective. I did not obtain better ones until I had replaced the mechanical moving stage by a rigid stage. Dr. Maddox has suggested the idea that the difficulty of obtaining these proofs may be due to dilatation of the cover-glass during the exposure.

'As source of light I employ exclusively, for my microscopical researches, the incandescent electric lamp, and that since the month of November, 1881, when I applied it to the microscope. My electric installation is very complicated, for it lights not only my microscope, but also a portion of the house, and especially my cabinet of work, which is very large and occupies all the second and third floors of my house. The light is produced by an Otto gas engine of  $1\frac{1}{2}$  horse-power; it actuates a Siemens dynamo machine which charges large accumulators.

'I use Swan lamps exclusively. I have tried all the electric lamps possible and have finally concluded that the Swan are the only good ones, for they alone permit one to obtain a white light without injury. It is well known that the blue and violet rays which exist in abundance in white

light permit the resolution of difficult details. This is one of the advantages which I proclaimed in 1882 in favor of the electric light.

'At times I use the small lamp for the microscope (micro-lamp A) of Swan, but generally I give preference to the lamp of six volts, a very perfect form of lamp which Mr. Swan had the kindness to make for me in 1882. This lamp gives white light with three accumulators, but one can operate it very well with three Bunsen elements.

'As concerns the photographic apparatus, the simplest is the best. I first commenced with an outfit like that of my friend Dr. Woodward, that is to say, I devoted an entire perfectly dark room to the photographic apparatus, where the microscope could receive at will light from electricity, the oxyhydric light, or from the sun with the aid of a heliostat, but I soon found that it was not what I wanted and that, save in very rare cases, photography should be, for the micrographer, not an end but a means; that is to say, that one should employ photography not for the pleasure of producing pictures, but to replace the camera lucida and the pencil, in case the latter could not render excessively delicate details sufficiently well, or when it is desirable to show a certain and undeniable proof in support of a newly asserted or controverted fact.

'For all that the installation of Woodward is not what is required. One is not certain when an object with very fine details is taken from the microscope that it can be placed under another microscope in the same conditions of illumination. In any case this cannot be done without great loss of time.

'My second apparatus consisted of a camera as perfect as possible (a model of Watson's), quarter-plate size, carrying in place of the photographic objective a tube containing a Tolles amplifier. This camera was mounted on an elevated inclined plane,

and so disposed that, an object being in the field of the microscope, to photograph it one has only to remove the ocular, place the photographic apparatus against the tube and make the photograph. This arrangement served very well, and it is thus that I made my first good photographs of the beads of the amphipleura.

Finally I constructed a still more efficient device, which I have named my automatic apparatus. This consists of a very small mahogany camera, extremely light, receiving at its posterior part a gelatino-bromide plate of  $4\frac{1}{2}$  centimetres wide by  $5\frac{1}{2}$  in length. Anteriorly the camera carries a copper tube  $5\frac{1}{2}$  cm. in length terminated by an amplifier of Zeiss, which is much better than that of Tolles. The copper tube enters the tube of the microscope a short distance. I call this apparatus automatic because I have nothing to do with it in any way. It is so regulated that the object is perfectly in focus with the No. 1 ocular of Powell & Lealand and also on the sensitive plate.

This effect is, naturally, only obtained with certain objectives. As it is, my apparatus works admirably with the  $\frac{1}{12}$  and the  $\frac{1}{18}$  homogeneous objectives of Zeiss, and it gives with the former a magnification of 300 and with the latter of 450 diameters. For considerably greater magnifications one should make enlargements from the plate, which offers less difficulty.

With this small apparatus I have been able to photograph, without trouble, very difficult things, for example, diverse groups of Nobert's test, including the 19th band.

Since writing the above we have received a communication from Dr. Van Heurck, which he has desired us to publish. We do so with pleasure in this connection. He writes as follows:

'I have received No. 62 of the *Am. Micr. Journ.* You certainly have the right not to admit the photography of the pearls of *Amphipleura pellucida*

before having seen the proof; but it appears to me that you should, however, believe me sufficiently expert in micrography and experienced in studying diatoms, to not presume that I would take for beads illusory lines which are easily seen upon *Amphipleura*, but which are always parallel to the margins of the valve.

'I would only say that the striæ which I have photographed are absolutely identical with those of *Amphipleura Lindheimeri*, which I have likewise photographed, and in all respects analogous to those of *Van Heurckia rhomboides*, a genus which leads to *Amphipleura* by the variety *amphipleuroides-grun.*, of New Zealand.

'I would add, finally, that eminent diatomists, such as Messrs. Cox and Kitton, admit that there is not the least doubt. Mr. Cox has written to me that "There ought to be no question as to the complete conclusiveness of the evidence. It is as plain as in the case of *Van Heurckia rhomboides*." Mr. Kitton says, "There is no mistake, the granules are distinctly visible; not that I ever doubted their presence." Finally, Prof. Abbe authorizes me to state that, in his opinion, there is not the least reason to doubt the reality of the pearls (restrictions made as to the real nature of what diatomists have designated as "pearls"); that the structure is analogous to that of many other diatoms, and that my photographs clearly show the typical image que doit donner, avec nos microscopes actuels, une structure périodique double (dans deux directions placées à l'angle droit) à intervalles si petite qu'il ne peut pénétrer, dans le microscope, au maximum, que trois des faisceaux des plus intérieurs que donne une pareille structure.'

We despair of rendering the latter part of the concluding sentence in good English, and therefore transcribe the original French. The question of the reality of the beaded



appearance is now definitely settled by the photographic record. It remains for some of our experts with fine objectives to repeat the observations of Dr. Van Heurck, and we hope to hear from them before long.

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### Bulloch's Combination Microtome.

The method of cutting serial sections has, almost, it seems, within a few months, brought about a wonderful change in the methods of microscopical research in biology and embryology and to some extent also in pathology. The great importance of this method of investigation has led to the designing of various forms of microtomes in Germany and England. Mr. Bulloch now offers one which he regards as an improvement over all the others. He has already sold several of them, which seem to have given perfect satisfaction.

The illustration, fig. 12, is one-fourth the natural size, but the height seems to be somewhat exaggerated in proportion to the length, owing to the

perspective of the view. The price of the complete instrument is \$65.00. Mr. Bulloch has prepared the following description for this JOURNAL:—

This microtome, which has lately been constructed by W. H. Bulloch, is claimed to be a combination of the best points of the German and French instruments with some of his own improvements. The illustration will give a general idea of the construction. The main slide for the knife-carrier is  $10\frac{1}{2}$  inches long; the height to the cutting edge of the knife  $5\frac{1}{2}$  inches; the knife-carrier is made with eight ivory bearings—four on each side—which provide a smooth and easy running surface, which does not require to be lubricated. At each end of the main slide there is a stop with rubber cushions to prevent the carrier passing over the end. The upper surface of the knife-carrier is made adjustable; so the knife can be made to cut at whatever inclination is found best. The knife can also be placed at any angle for cutting, or adjusted to cut at right

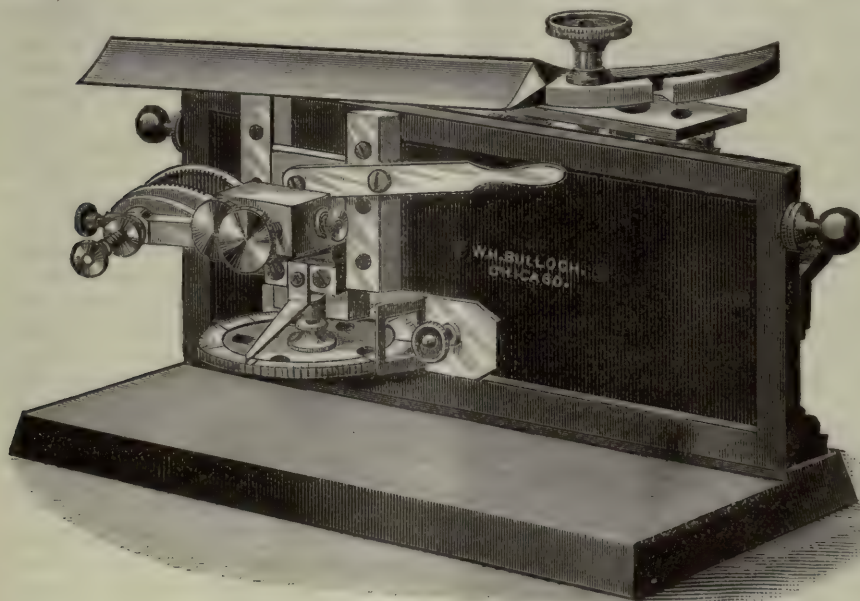


FIG. 12.—Bulloch's Combination Microtome.

angles for cutting sections in ribbons.\* The screw for elevating the slide and holder is graduated to  $\frac{1}{300}$  mm., about  $\frac{1}{3000}$  of an inch, and with a spring click for registering. The spring click can be turned aside when not required.

The holder for material to be cut has universal motion, so that the specimen can be adjusted to be cut at any plane. Each movement is independent of the others, and all are so combined that the specimen is not raised or lowered in adjusting. For the convenience of using the knife square, or at a right angle to the direction of motion of the knife-carrier, and also for cutting sections in ribbons, the holder is reversible, in which position the specimen is in about the center of the slide. There is also the German freezing attachment, with atomizer.

The base and upright are of japanned iron, the other parts of brass, nickel plated. The case is so made that it is not necessary to remove the instrument when operating, as it unfolds and will lie flat on the table.

—o—

### Pseudo-Cyclosis.

BY SAMUEL LOCKWOOD, PH. D.

A bottle holding scarcely more than an ounce of water, which is occasionally replenished, has had a place for several months in the full light of my study window. When first placed there it contained a little ooze, which was skimmed from the surface of the mud at the bottom of a field pond. For microscopical uses it is really a miniature pond, so prolific has it proved in the numbers and forms of pond-life, for it teems with protococcus and other algæ of a little higher rank, as well as desmids and diatoms, also rhizopods and infusoria.

To-day, Jan. 30th, I took a drop from the surface of the mud and put it under the microscope. A fine *Ro-*

*tifer vulgaris* popped into view. But this attractive object was deserted for another less showy, but more interesting on account of a weird-like novelty of its own. It seemed to be a translucent tube with a stream of minute objects coursing along its entire length. At first sight the semi-transparent body was mistaken for a unicellular plant, and the streaming bodies for globules of protoplasm. In a word, such was the perfect delusion, that the movement was taken for the phenomenon of cyclosis. A  $\frac{1}{18}$  water immersion and B ocular were at last employed. The bluish-green of the moving bodies, denoting phycocrome, 'a mixture of chlorophyll and phycocyanin,' did not favor the cyclosis view—and the high powers now patiently used swamped the entire hypothesis. The containing body was not a cell, but a minute particle of limpid living gelatine. Whereas the tinier green bodies were hyaline cellules, each one being a unicellular plant. The movement of these tiny globules was in one direction only. There was no return path to complete the cycloidal track, as in the movement of the protoplasmic pellets in a growing vegetable cell.

The conclusion is now patent to all. It was *Amœba diffluens*; yet in the numbers I had seen only this had produced such a delusion. The contained bodies were one-celled algæ. As the scene held me almost fascinated an entire hour, let me tell what I saw, and in such way that the tyro may go along.

Our amœba is very active, progressing with a gliding or flowing motion, as a drop of tallow on a warm glass. True, life is manifestly present, but it is life actuating an infinitesimal speck of amorphous protoplasm. There is no appearance of organized tissue or fibre. Hence there cannot be anything like muscle. Occasionally may be seen one or two contractile vacuoles—really pulsating vesicles. Let us here premise that

\* Some authorities claim that for cutting fibrous tissue or hard sections a long sliding cut is preferable, whereas for cellular or soft tissue a cut square across is best.



these little bodies, nearly thirty in number, are amœba's dinner. It is gorged, and the work in hand is to digest the rich repast. As amœba advances the green bodies are left in a cluster at its hinder part. Now the amœba's movement stops, and now the little spheroids begin rushing in a well-defined stream towards the advanced portion of the protoplasm. They seem tiny greenings bowling along a grassy way. Again the containing body advances, and those contained recede—that is, are left at the hinder part of the protoplasm. We notice also a resting of the host, and the rush forward of the smaller bodies. The amœba again advances, this time but a very little. It seems even to recede. Really it contracts, then spreads out unsymmetrically on two sides, producing an object not unlike the ankle and foot. Now comes the usual rest, succeeded by the movement of the contained bodies, which this time start in two streams, the smaller group towards the heel and the larger to the toes of the so-called foot. This alternating of the two kinds of activities is quite interesting to witness: the streaming inner movement always obeying two facts—following a rest of its own, and taking the occasion of a rest of the amœba.

As to this rest of the amœba, is it actual or only apparent? As to progression, it is an actual rest, but I cannot imagine this throbbing and rapid streaming to be due to any osmotic force. Its regularity really suggested a systole and diastole contractility of the pulsating vesicle. Says Gegenbaur: 'Any place in the protoplasm can act as a digestive cavity by enveloping and absorbing nutritive matter, and at any neighboring part of the surface the undigested substances can be expelled.' Hence the object of this streaming of the little bodies into every projected lobe or new pseudopodium, thus bringing the food into actual contact with every molecule of the gelatin

body, making the entire body to take part in the digesting, and securing to the whole an equal alimentary distribution.

This microscopic speck of life-stuff, or, as Clarke calls it, 'transparent sarcode—structureless animal tissue,' has no composition of parts. The exterior is likely a little denser than the interior, in which is that little cavity which may come and go, that is, be and not be, which is called a vacuole. Hence such terms as endosare, ectosare, endoplast, and others, are rather too subtle and refined. Yet Clarke describes and figures his structureless being as revolving its food in true cycloidal movement. The scene I have described was witnessed for one entire hour. In every instance the food propulsion was a movement in the direction of the outward or forward flow or progression of a part of the amœba, and this was always followed by an illusory recession, that is a seeming stream of the little algæ backward, caused by the advancing protoplasm leaving these objects behind until the new pseudopodium rested, when the trend of the little bodies immediately advanced. For this phenomenon I have used the word pseudo-cyclosis. My desire was to watch until digestion had become complete, but this privilege was denied.

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### Method of Analysis of Fibres, Tissues, Etc.\*

By testing all the fibres we have enumerated, and using the indications we have given, one is able to identify them with certainty and without difficulty, whether they are alone or mingled with others, in the form of a tissue, or any product of agriculture or industry. But inquiries of this kind are often simplified and much facilitated by working methodically. We think, then, we are rendering a service by furnishing a table in which we have arranged in a certain order the more

\* From 'Études sur les Fibres,' by M. Vétillard. Translated for this JOURNAL by Rufus W. Deering.

prominent characteristics which permit us to distinguish fibres from each other.

To simplify this mode of analysis, and permit the reader to thoroughly understand it, we shall take into consideration only a limited number of plants the fibres of which we have studied; they are those which are to be found in thread, tissues or cordage which may be met with to-day in the markets of Europe.

The results obtained will be plain at first sight only in proportion as the specimen be crude or imperfectly bleached. In both cases it will be necessary to boil it in a solution of carbonate of soda and to disintegrate it by braying in a mortar, as we have already explained. The analysis of white or dyed tissues gives results quite as accurate, but demands a certain experience in these researches, and the most scrupulous care.

The mode of procedure is the same whether the specimen be composed of filaments of one kind or of a mixture of many textiles. This process differs from the method of chemical analysis in that the latter necessitates the employment of many reagents in succession, each test indicating the presence or absence of one or more substances; while the method which we propose employs only a single reagent, complex, it is true, but the same in all cases, and which, added to the indications given by the microscope, permits us to identify the filaments enumerated, or the presence of a number of them at the same time in one specimen.

We divide the fibres into two classes:—

Class A embraces those which are colored blue by the reagents;

Class B, those which take a yellow color under the same conditions.

The letter L indicates the average length of the fibres; D, the average diameter; R, the proportion of the average length to the average diameter. Each class will be divided into two sections: Section I will contain

the fibres obtained from the dicotyledonous plants; Section II, those from the monocotyledonous.

## CLASS A.

### SECTION I.

#### *Dicotyledons.*

This section includes Flax, Hemp, Hop-fibre, the common Nettle, the Chinese Nettle, the Paper Mulberry, the Sunn Hemp, the Broom and the Cotton plant.

1. Sections blue or violet, not enclosed in or surrounded by a yellow border; with yellow in the inner cavity.

a. Sections polygonal with straight sides, having angles more or less acute; in the center a yellow point; concentric layers of growth slightly indicated.

Fibres of a blue color, transparent, regular, smooth or slightly striated; folds of a blue color somewhat depressed by the swelling of the body of the fibre; central canal represented by a narrow yellow line, granulated; with slender, sharp points.

L. 25<sup>mm</sup> to 30<sup>mm</sup>; D. 0<sup>mm</sup>, 020;

R. 1200 . . . . . FLAX.

b. Sections oval, flat or with re-entrant angles; partitions somewhat thick; concentric layers of growth well marked, many individual ones showing radiating striæ in the interior layers; central cavity often filled with a yellow granular substance.

Fibres blue or violet, irregular, often striated, folded, or in ribbons; central canal generally large and containing yellow granular masses; slender points, rounded at the end, sometimes truncated or bifurcated.

L. 27<sup>mm</sup>; D. 0<sup>mm</sup>, 05;

R. 550 . . . COMMON NETTLE.

c. Sections polygonal or irregular, of very large size, often with re-entrant angles; the inner opening large and irregular, sometimes containing masses of yellowish-brown granules; many well-marked concentric layers of different tints; radiate striæ in the interior layers of growth in many sections.

Fibres blue or violet, some of them



of great size, irregular in form and thickness in the same specimen; sometimes full, smooth or striated, sometimes flattened, folded, or in ribbons, the central canal visible, often containing isolated masses of yellow or brown grains; points elongated, terminating in spade or lance-like or rounded forms.

L. 120<sup>mm</sup>; D. 0<sup>mm</sup>, 05;

R. 2400 . . . CHINESE NETTLE.

d. Sections blue or violet, always isolated, rounded, oval, kidney-shape, etc. . . . ; central cavity often containing yellow granular masses.

Fibres blue or violet, never in bunches, ribbon like, striated, in folds, twisted upon themselves, presenting on each side a round border like a hem . . . . . Cotton.

2. Sections blue or violet, polygonal, rounded, or of irregular form with re-entrant angles, circumscribed by a yellow thread.

a. Irregular groups of polygonal sections with central linear opening, simple or with many branches or of irregular form with re-entrant angles and large opening, entangled with each other in groups where they appear in close contact; concentric layers with growth very plainly marked and often of different tints. No yellow granulations in the interior.

Fibres blue, of a greenish or dirty yellow color, of irregular diameter, frequently collected in compact bundles, striated or grooved, showing a few small fibres, detached or still adhering; marked by cross lines, almost black and very fine; central canal somewhat difficult to recognize, large, flat points, terminating in the form of a spade, etc. . . .

L. 22<sup>mm</sup>; D. 0<sup>mm</sup>, 022;

R. 1000 . . . . . HEMP.

b. Numerous groups, compact, well arranged, frequently taking the form of a cross; composed of sections which have great analogy to those of hemp; although the entire sections, polygonal or oval, very often have a small round cavity, not linear; this cavity is some-

times garnished with yellow granulations. Many fine, well-marked growth-layers are seen, those on the outside sometimes colored yellow, while those on the inside are blue. Yellow network, usually thick, enclosing the sections. Frequent openings cross the walls of the fibres and join corresponding openings of neighboring fibres. The hollow part of the cross is sometimes adorned with round or oval groups composed of network of a subduced yellow, with large or small meshes.

Fibres blue, green or yellow, some nearly full, sometimes containing yellow or brown granular masses; others flattened, in ribbons of which the interior is empty. The body of the full fibres presents folds in the form of a cross, and swellings like flax, but the central canal attains dimensions that are not found in flax; ends like those of hemp.

L. 7<sup>mm</sup> to 8<sup>mm</sup>; D. 0<sup>mm</sup>, 03;

R. 260 . . . . . SUNN.

c. Groups not large, composed of small blue sections, quite uniform in size, enclosed in a yellow network to which they adhere slightly and whose meshes are sometimes empty; their form has great resemblance to that of hemp; but with more compact walls, marked by a few concentric layers, generally not very distinct; central cavity almost always open containing a yellow substance like grain.

Longitudinal bunches not easily divided with a needle; fibres blue, very fine, of uniform size, separated, distinct even in bunches; color sullied sometimes by a yellow envelope which then appears on each side of the fibre like a straight, brilliant yellow line.

There are two kinds of fibres: one full, smooth and clear; central canal indistinguishable except when it contains masses of yellow granulations, points sharp and slender; the other, flat, deeply striated, ribbon like; interior canal empty, scarcely ever visible; the points of the latter large and rounded.

L. 10<sup>mm</sup>; D. 0<sup>mm</sup>, 016, for the full ones;  
R. 620 . . . . . HOPS.

d. Groups presenting two types; one containing sections of ten, very large, full or with thick walls; polygonal in form, with obtuse or re-entrant angles and rounded contours. The other quite voluminous, composed of very small sections of a clearer blue, their forms rounded, but sometimes irregular and distorted. These two kinds of sections are enclosed in a yellow network slightly adherent, whose meshes are often empty. The isolated sections separated from the meshes appear like sections of cotton, but they present to view many well-marked concentric layers which sometimes distinguish them; the central opening often contains a yellow granulated substance or one which remains without color.

Longitudinally, bundles easily divided with needles into a confused mass of large and very fine fibres, well separated from each other; these are full, smooth or striated, with plainly marked folds of flexion, or else they are in ribbons; the central canal rarely apparent, or indicated by detached masses of yellow granulations which show themselves toward the points; the latter fibres have rounded ends usually large.

L. 15<sup>mm</sup>; D. 0<sup>mm</sup>, 025, p. the largest;  
R. 430 . . . . . PAPER MULBERRY.

c. Small groups of not very large blue sections, separated by a yellow, generally thick, network; forms rounded, some with salient angles, very full, with central opening very small, pointed or linear, often filled with yellow grains. Concentric layers few, but plainly marked; the outer layer paler than the interior and sometimes tending to a yellow color. The other sections irregular, like those of the hemp but much smaller, having a less pronounced tint than the full ones; central cavity linear or open, sometimes garnished with yellow grains. Groups of woody fibres are frequently present, recognized by their yellow color.

Fibres blue, violet or yellow, short, curly, full, round, regular, and of very small diameter; the central canal is indicated by a very fine line; the yellow envelope often overlaps the points which are not usually slender, but rounded at the end, bifurcated and sometimes furnished with lobes.

L. 5<sup>mm</sup>; D. 0<sup>mm</sup>, 015;  
R. 400 . . . . . THE BROOM.

## SECTION II.

### *Monocotyledons.*

This section includes the *Alfa* (embracing under this name the *Lygeum Spartum* as well as the *Stipa tenacissima*) and the Pine Apple (*Ananassa sativa*.)

1. Irregular groups composed of blue intermingled with yellow sections; the concentric layers often plainly marked, the outer one sometimes colored yellow, the inner ones being blue; forms rounded or oval, rarely presenting straight surfaces or sides; in the center a point, often of a yellow color, indicates the inner canal. These sections are accompanied by groups showing the yellow fibro-vascular bundles.

Fibres short, blue, fine, very full, smooth, curly and of a uniform and regular diameter; having a very fine yellow line in the middle representing the central canal; the points are rarely slender, but rounded, truncated, and bifurcated or notched.

L. 1<sup>mm</sup>, 5; D. 0<sup>mm</sup>, 012;  
R. 125 . . . . . ALFA.

2. Groups very compact, quite voluminous, and often in the form of a cross; very small sections of the fibres of a blue or very pale violet tint only appearing when they are very thin. These sections are enclosed in a quite thick yellow network; their forms are usually rounded, but sometimes polygonal; the cavity appearing in the form of a point or a very short line. The thick sections are greenish or even yellow. Among these groups are found sections of fibro-vascular bundles, in which the tissue which fills the center is of a blue color and surrounded by a border formed by one



or two rows of thick fibres of a subdued yellow color.

Longitudinally, fibres very fine, regular, full, smooth, pliable, and curling easily; the central canal is rarely visible in the smaller ones, appearing in the larger like a very fine line; fibres very distinct in the bundles, from which they are easily separated; points elongated and sharp. Color not very marked, often entirely wanting. Among these almost colorless fibres are found larger ones, very stiff and not so long, protruding from the inner line of the fibro-vascular bundles.

L.  $5^{\text{mm}}$ ; O $^{\text{mm}}$ , 006;

R. 830 . . . . . PINE APPLE.

## CLASS B.

### SECTION I.

#### *Dicotyledons.*

This section is composed of the Hibiscus, the Flag, the Jute and the Daphne.

1. Polygonal sections with straight sides, the central orifice rounded or oval with smooth edges.

*a.* Sections yellow, polygonal, with straight sides and sharp angles, enclosed in a network of a rather subdued yellow, forming compact groups of rectangular shape; central opening generally small, always rounded, smooth and empty; concentric layers sometimes of marked thickness; fissures in the walls, perpendicular to the exterior and interior contours.

Longitudinally, fibres yellow, stiff, broken, very irregular in diameter; with slender points rounded at the end, some having notches or sinuities; fibres frequently found having very thin partitions and in ribbons.

L.  $5^{\text{mm}}$ ; D. O, 021;

R. 240 . . . . . HIBISCUS.

*b.* Sections generally very small, polygonal, with straight sides and sharp angles, collected into compact groups, enclosed in a network of a rather subdued yellow, with very fine meshes, which they exactly fill; central orifice very small, punctiform.

Longitudinally, fibres, very short,

fine, stiff, very full, with sharp or irregularly formed points.

L.  $2^{\text{mm}}$ ; D. O $^{\text{mm}}$ , 016;

R. 125 . . . . . FLAX.

*c.* Polygonal sections with straight sides and sharp angles, forming very compact groups, or else found in close contact; central orifice generally quite large, round or oval, with smooth edges, always empty.

Longitudinally, fibres of a golden yellow color, collected into compact bunches, very short, stiff and smooth, not striated, but often presenting notches or curves on the edges, especially near the points. The central canal appears in the form of a distinct band in the center of the fibre; on each side borders of a subdued yellow indicate the thickness of the partitions, defined by very plain lines; the ends terminate abruptly, being rounded or of irregular shape.

L.  $2^{\text{mm}}$ ; D. O $^{\text{mm}}$ , 022;

R. 90 . . . . . JUTE.

2. Round, oval, or bent sections, like those of cotton, to which they are very similar in form, but from which they are distinguished by their yellow color; interior cavity elongate, linear and empty.

Longitudinally, fibres, very fine, yellow, smooth and not adhering to each other; many specimens very large toward the center, tapering rapidly to slender, rounded ends; the swelling sometimes very marked in the folds.

L.  $5^{\text{mm}}$ ; D. O $^{\text{mm}}$ , 01;

R. 500 . . . . . DAPHNE.

### SECTION II.

#### *Monocotyledons.*

This section contains *Phormium tenax*, Abaca, the Coco, the Sansevieria and the Pita or Aloes.

1. Sections the forms of which are more often rounded than polygonal, and whose central orifice is also rounded; with traces of fibro-vascular bundles.

*a.* Very small sections, of a pale yellow when thin; those which have polygonal forms have obtuse angles;

they do not adhere much to each other; the central orifice is small, round or oval, with smooth edges.

Longitudinally, fibres, fine, regular, smooth, straight and stiff, easily separated from each other in the bundles; thickness of the partitions very uniform; central canal small but very distinct; points elongated and sharp.

L. 9<sup>mm</sup>; D. 0<sup>mm</sup>, 016;

R. 560 . . . . . PHORMIUM.

*b.* Polygonal sections with very obtuse angles or oval shapes; very close contact between the groups; partitions generally of moderate thickness; central orifice large, resembling in its form that of the outer perimeter, but the angles are so small that the opening appears nearly round or oval; it sometimes contains brown granulations.

Longitudinally, fibres, smooth, regular, of a very uniform but inconsiderable thickness; central canal large and plain; points tapering regularly and gradually, sharp or slightly rounded at the end.

L. 6<sup>mm</sup>; D. 0<sup>mm</sup>, 020;

R. 250 . . . . . ABACA.

*c.* Sections of a yellowish brown color, round or oval, scarcely touching in the groups, enclosed in a network of thick meshes, which unites them into very compact groups, having in their center an empty space or gap of irregular form; the central orifice of the fibre very large, round or oval.

Longitudinally, fibres, very short, stiff, with quite thick partitions, not equalling, however, the size of the interior canal; the exterior contours often sinuous or toothed; walls sometimes interrupted by solution of continuity (pores?); points rounded or abruptly terminating; brown bundles very compact and easily separated.

L. 0<sup>mm</sup>, 7; D. 0<sup>mm</sup>, 020;

R. 35 . . . . . COCO.

*2.* Sections polygonal, clearly defined; central orifice equally polygonal, with angles more or less diminished, and traces of fibro-vascular bundles.

*a.* Polygonal sections, often with obtuse angles, partitions not very thick; central orifice polygonal, with smooth and angular perimeter, always empty. Longitudinally, bundles, very compact, almost indivisible, composed of fine fibres, smooth, stiff, with thin partitions, of uniform thickness; central canal large; points sharp, slender.

L. 3<sup>mm</sup>; D. 0<sup>mm</sup>, 020;

R. 150 . . . . . SANSEVIERA.

*b.* Polygonal sections, with straight sides and angles sometimes a little blunted; central opening very large, polygonal, with angles less pronounced than the outer ones; fissures in the walls, perpendicular to the exterior and interior contours.

Longitudinally, fibres, short, stiff, with thin walls swelled toward the centre; thickness of the walls very unequal; the outer profile often wavy or toothed down to the large point shaped like the scabbard of a sabre and sometimes bifurcated.

L. 2<sup>mm</sup>, 5; D. 0<sup>mm</sup>, 025;

R. 100 . . . . . PITA.

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### Vorticellæ with two Contractile Vesicles.

BY DR. A. C. STOKES.

Recently I sent to the *American Naturalist* a communication to the effect that not only does *Vorticella Lockwoodii* Stokes possess two pulsating vacuoles, but that the same number is apparent in *Vorticella monilata* Tatem, and I expressed surprise that this fact should have been for so long overlooked, since the last-named form is not uncommon in Europe nor rare in our own waters. My wonderment at such an oversight is not now so great as it was, for hardly had the manuscript to the *Naturalist* passed out of my hands when I captured two individuals of *Vorticella vestita* Stokes, which had not been previously obtained since its description in this JOURNAL of November, 1883, and I found that



the observers of *V. monilata* were not alone guilty of an oversight, for in *V. vestita* there are also two contractile vesicles. It then occurred to me to repeat the examination of *V. rhabdophora*, described in *The Microscope* for February, 1885, and in it also two pulsating vacuoles were now observed. To have overlooked them in this case is peculiarly annoying, for when the species was first obtained from the vegetable infusion where it appeared in abundance, this possibility was borne in mind and the double organ searched for. In all these instances, however, the contractile spaces are usually placed directly opposite each other and, unless the vorticella is in a certain position, a single one only is visible as one obscures the other, the lower being so far beyond the focus of the objective that its pulsations are not noticeable.

The presence of the double vesicles is not only an interesting and important structural point, but it is especially worth of note since the two have thus far been observed only in such members of the genus as possess some form of cuticular investment, or of surface ornamentation rather than transverse striæ, *V. vestita* being surrounded by a well-marked cellular coating, *V. rhabdophora* having an apparently mucilaginous covering enclosing minute bacteriform bodies, *V. monilata*, as the name signifies, bearing solid bead-like bosses over its entire surface, and *V. Lockwoodii* possessing similarly arranged but conspicuously nucleated cuticular elevations. As these species are apparently more highly organized and presumably somewhat higher in the scale than are the smooth or simply striated forms, so are they slightly more complex in structure.

TRENTON, N. J.

### A Growing Slide.

Many are the working hints I receive from the columns of the JOURNAL, yet, after all, I am often, like every working microscopist, thrown

upon my own resources. One of my devices has proved to be so useful that I will describe it. It is a growing slide, made as follows:—Arrange the specimen on an ordinary glass slide, with a drop of water and cover-glass as usual; then confine the cover by slipping a light rubber band over it on the slide, and place the slide in a dish of water of sufficient depth to completely immerse the specimen. In this simple manner I have kept fresh-water algæ for weeks in a growing condition, enabling me to observe the process of conjugation from its commencement to the final rupture of the spores and formation of new filaments. E. L. CHEESEMAN.

KNOWLESVILLE, N. Y.

### Structure of Diatoms.\*

[23806.]—The daily-increasing number of disputable or, at all events, disputed questions connected with the intimate structure of the diatom valve and frustule will, I hope, be accepted by your readers as a sufficient reason for the present attempt on my part to determine the point raised by Dr. Flögel, and answered in the negative (erroneously in this instance, as I venture to believe) by my valued correspondent Mr. J. D. Cox, of Cincinnati, Ohio.

Flögel maintains, on the strength of sections which I have seen and very carefully examined, in conjunction with these accompanying photographs, that in such genera as *Triceratium* and *Coscinodiscus*, the little hexagonal or cylindrical cavities, though completely closed by a silicious film on the internal surface of the valve, are *not* closed by any such membrane on the outer surface of the valve. Mr. Cox, on the other hand, strongly insists on the cellules being closed by a silicious film externally as well as internally. Of course, if Mr. Cox's view be correct, we have here to deal with minute hermetically-sealed cavities.

Now, to my mind, the objections

\* From *English Mechanic*.

to Mr. Cox's supposition are insuperable, irrespectively of the visible evidence obtainable from broken-up specimens which I have been in the habit of studying ever since I began to write on the diatoms some five-and-twenty years ago.

If the cellulæ are closed at both their extremities during the life of the organism, each individual cellule must be full either of protoplasm or some other more or less fluid substance, unless, indeed, each contains a gas, or constitutes a perfect vacuum, which is scarcely within the bounds of possibility. If each chamber contains protoplasm, it is obvious that the remains of this, during the preparation and mounting of the specimen, would be recognizable amongst the larger species, either by the employment of optical or chemical tests—that is to say, during the boiling in acid, or burning on mica, the fluid contents would burst the films, and in many cases leave behind the evidence of their former condition. Now, in my experience, such evidence has ever been forthcoming, and, judging from what is known of cellular structure in organic life generally, whether animal or vegetable, there are no examples of truly vacuous cavities, inasmuch as all organic tissues whatever are pervious to dialytic or osmotic action.

It is no doubt true that the organic silica of the diatom, perfectly hyaline as it looks, is in reality a 'colloid,' and hence, as it contains an infinitesimal percentage of water, just as flint itself does, dialytic action may take place through the film under notice.

But even then the perviousness to moisture of the diatom, if it really keeps the chamberlets full of fluid during the vitality of the organism, would not suffice to settle the present question; for, if any fluid whatever remained in the little cellulæ, should the specimens have been but recently taken from their element, it would burst the film on the application of heat, and inevitably burst the walls,

whilst traces of the disruption would occasionally be visible under the microscope. Again, if the chamberlets contained gas of any kind, and in spite of the effects of the boiling in acids, this gas were too minute in quantity to burst the walls, we should certainly be able to detect gas bubbles in some of the chamberlets. But, as is well known, the bubbles so common in mounted specimens are not due to the cellulæ having originally contained gaseous material, but to the accidental admission of air during mounting.

The only remaining alternative is that the cellulæ cannot be considered closed cavities, and hence that the alleged presence of an external investing and closing film is illusory—a fact of which I have never yet had reason to entertain a doubt.

G. C. WALLICH, M. D.

LONDON, Jan. 25.

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### The Working Session of the American Society of Microscopists.

The Executive Committee of the American Society of Microscopists having placed in my hands the work of organizing the Working Session at the meeting of the Society to be held in Cleveland, Ohio, next August, I have prepared the following scheme of work for demonstration at that session, which, though far from being as complete as could be desired, is submitted as approximating the maximum of work that can be successfully elaborated and demonstrated in the limited time of the working session—one-half day.

#### SCHEDULE OF WORK.

1. The use of the micro-spectroscope and its application to original research.
2. The use of the polariscope in original research.
3. Micro-photography and its applications as an aid to research.
4. The use of the camera lucida, various styles and methods.



5. Micrometry, exposition of different methods.

6. Cultivating bacteria, exposition of different methods.

7. Injecting vessels and tissues, demonstration of various methods.

8. Staining tissues in mass, simple and compound stainings.

9. Staining sections, simple and compound stainings.

10. Section cutting, soft tissues, use of various microtomes.

11. Section cutting, hard substances, methods of cutting and grinding.

12. Section cutting, serial sections, S. H. Gage's methods.

13. Use of dissecting microscope, methods of dissecting, etc.

14. Practical demonstration of the relation of aperture to power in objectives.

15. Methods of measuring aperture, power, focal length, etc.

16. Methods of manipulation, decantation, desiccation, isolation, etc.

17. Methods of illumination for special purposes, special objects, etc.

18. Uses of the mechanical finger, applications to research, etc.

19. Electrical and thermal applications, uses of hot stage, etc.

20. Uses of live boxes, growing cells, troughs, compressors, etc.

21. Special methods of treatment or examination of special subjects, such as blood, pus, sputum, urine.

22. Staining and mounting bacteria, micrococci, etc., for examination.

23. Special methods of cell making, cementing, cover cutting, etc.

24. Special methods of mounting, labeling, finishing, packing, and storing slides, etc.

All microscopists who expect to attend the Cleveland meeting and are willing to take part in the working session, and assist in the above demonstrations, are cordially invited to communicate with me on the subject as soon as possible, and any suggestions regarding the Working Session and the subjects to be presented

and demonstrated there will be very welcome.

Every indication so far points to a large and successful meeting at Cleveland, fully equal to any of the preceding meetings, and it is hoped to make the working session a valuable feature of the meeting. The active co-operation of microscopists who are interested will insure such a result.

C. M. VORCE.

CLEVELAND, Ohio.

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### Culture Media for Bacteria.

In the *Journal of the American Medical Association*, under the head of Foreign Correspondence, a writer in Berlin gives some information concerning the preparation of solid culture media. We print the greater part of two letters, as they seem to be written by a person of experience in the culture of micro-organisms.

The method of preparing the flesh-peptone-gelatin is given as follows:—

Half a pound (0.25 kilo.) of fresh lean meat (beef or mutton) is finely chopped, and to it is added a pint (500 c.c.) of distilled water, the mixture remaining in a cool place for twelve to twenty-four hours. It is then strained through fine linen gauze, the mass being pressed to extract all the liquid, which appears as a reddish-bloody fluid. To this pint of "flesh-water" in a clean flask is added 75 grains (5 grammes) of peptone, 30 grains (2 grammes) of common salt, and from 1 to 2 ounces (30 to 60 grammes) of fine gelatin, and to the flask is fitted a cotton-wool stopper. The mixture should then stand for a half hour to allow the gelatin to swell up, and as gelatin has an acid reaction, enough sodic carbonate ( $\text{Na}_2\text{CO}_3$ ) should be added to make the solution neutral or very slightly alkaline; because most germs do not grow in an acid solution. The solution is then placed in a Koch's steam sterilizer and cooked for an hour. This is an apparatus made of tin and covered with thick felt, by which the

articles placed inside are exposed to the direct action of a large volume of steam.

'The solution is then filtered hot through filter-paper, and it comes through clear and yellow. This is best done by means of a hot-water filter, which keeps the gelatin thoroughly melted all the time. If this, however, is not at hand, the ordinary glass filter tunnel and its contents may be warmed by carefully and quickly throwing against it the flame of a Bunsen-burner or a spirit lamp. It should be emphasized that the filter and filter-paper, and the test-tubes, together with all the other apparatus used in the process, should be thoroughly sterilized in a sterilizing oven to a temperature of 300° F. (150° C.) for at least ten minutes.

'The next process is to fill the test-tubes, which have been fitted with a cotton-wool stopper and sterilized as above described. They are filled for about a quarter or a third of their length and are cooked for fifteen minutes in the steam sterilizer, when they are probably in a condition for use; but to make sure, it is better to cook them three days for fifteen minutes each day.'

\* \* \* \* \*

'There are two ways of using the gelatin which has been prepared according to the method I described last week, viz: plate cultures and tube cultures.

'(a) For plate cultures, which are especially useful to separate different forms of germs in a mixture, there is necessary an apparatus consisting of two bell-jars, a glass-plate, and glass-bridges. Of the bell-jars, which are about seven inches in diameter and two inches deep, one should be a trifle larger and a trifle less deep, to set over the other as a cover. The glass plate should be about six inches long and four inches wide, but this should be regulated by the size of the table to one's microscope stand, for we must be able to examine every portion of it by the microscope. The glass

bridges should be such as to elevate the plate about one-quarter of an inch above the bottom of the bell-jar. All of this, like everything, as I said before, should be sterilized in a sterilizing oven by exposure for ten or fifteen minutes to a temperature of about 300° F. (150° C), and then it is put together to cool, the plate resting on the bridges in the lower bell-jar, which is covered by the larger one.

'When cold it is so placed that the plate is exactly horizontal, and for this purpose especial levelers are sold, which, though convenient, are not absolutely necessary. The cover being removed, gelatin melted in a test tube is poured over the plate, so that when cold there is a layer about an eighth of an inch thick. The cover is replaced and all is set aside for the gelatin to harden, when it is ready for vaccination, which may be done in two ways. (a) Vaccination of the entire surface. This is accomplished by making a *very dilute* mixture containing the several germs it is desired to separate, and pouring this over the surface of the gelatin. (b) Vaccination in stripes. This is accomplished by dipping a platinum wire sterilized by heat into the *very dilute* mixture of germs and gently scratching the surface of the gelatin. This is repeated, making the rows from a quarter to a half inch apart. N. B. It is of great advantage to apply moistened filter-paper to the inner surface of the cover to make a moist chamber. Also, N. B. It is almost impossible to make too dilute a mixture, and beginners make a great mistake in this respect. Theoretically it should be so weak that any one germ of a kind drops in a place, and another at a little distance, and so on. This apparatus being kept at a temperature varying according to the cultivation, the plate shows, after twelve to forty-eight hours, little points which grow, and some of which may be distinguished from the rest. By using these as seed in successive fractional cultures the last becomes quite clean,



when it may be transferred to a test-tube culture.

‘(b) The test-tube culture is made in test-tubes filled as above described, about one-third of their length, and stopped by cotton-wool.

‘The vaccination is made by taking seed on a platinum wire sterilized by heat and thrusting it into the gelatin about an inch. In their growth many germs build characteristic forms.

‘Although no books give the information, it is to be noted that in making the vaccination the test-tube should be held inclined and with the *mouth* downwards when open, so that no outside germs may fall in from the air.

‘For certain culture gelatin has the disadvantage of melting at a comparatively low degree, and when a higher one is necessary aga-aga or blood serum is used.

‘Aga-aga is prepared like gelatin.

‘Blood serum is prepared by filling sterilized test-tubes one-third deep with clear serum from the blood of an ox or sheep, and cooking in the steam sterilizer at 135° F. (58° C.) for two or three hours. During this time the test-tube should be inclined at an angle of 45° to allow the serum to solidify in this position, which gives a much larger surface in the test-tube for vaccination. (N. B. Aga-aga may also be thus prepared.) The heating should be repeated for five days, when it is ready for vaccination with platinum wire.’



— Microscopists should always find delight in flower gardens. There is always a rich field for study where there is a variety of plants, some of them always blooming and ripening their fruit through the summer and autumn. Vick’s ‘Floral Guide’ for 1885 is a useful book of 150 pages, and 1000 illustrations of flowers, plants and vegetables. It is a valuable catalogue, from which one may make choice selections of seeds, of most excellent quality. Persons who are mounting seeds for the microscope would do well to send for a copy. It is sold for ten cents, by Mr. James Vick, Rochester, New York.

## EDITORIAL.

**Publisher’s Notices.**—All communications, remittances, exchanges, etc., should be addressed to the Editor, P. O. Box 630, Washington, D. C.

Remittances should be made by postal notes, money orders, or by money sent in registered letters. Drafts should be made payable in Washington, New York, Boston, or Philadelphia.

Subscription-price before April 1st, \$1 per year, in advance. All subscriptions begin with the January number. After April 1st the subscription-price will be \$1.50.

The regular receipt of the JOURNAL, which is issued on the 15th of each month, will be an acknowledgment of payment.

The first volume, 1880, is entirely out of print. The succeeding volumes will be sent by the publisher for the prices given below, which are net.

Vol. II (1881) complete, \$1.50.

Vol. III (1882) complete, \$2.00.

Vol. IV (1883) complete, \$1.50.

Vol. V (1884) complete, \$1.50.

Vol. V (1884), Nos. 2-12, \$1.00.

**PROCEEDINGS AMERICAN SOCIETY OF MICROSCOPISTS.**—The *Proceedings* of the seventh annual meeting, held at Rochester last year, were published several weeks since, but we have been unable to give them earlier notice in this place. The volume is an excellent one of 300 pages and five plates, with numerous illustrations in the text. A portrait of the late R. B. Tolles makes an appropriate frontispiece.

The articles published are not all of the highest degree of scientific value, but there is enough reading that is good and useful to make the volume worthy of a place in every library of microscopical works. We do not wish to be critical, but it is only proper to say that there are one or two articles published in the volume before us which have nothing more to recommend them than that they were read before the Society. We doubt very much if the publication of such papers does, in any way, encourage, or act as an incentive to, careful scientific work. It seems a pity that the Committee on Publication should not exercise discretion, and publish in full only articles of scientific value, letting the others go in by title or short abstracts.

The work of the committee has been done as quickly as could be reasonably expected, and as a whole it has been done very well indeed.

Copies of the *Proceedings* can be obtained from the treasurer of the Society, Dr. Geo. E. Fell, Buffalo, N. Y.

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#### TEXT OF SYNOPSIS OF DIATOMS.—

The text of this valuable work will be issued in a short time, probably next month. It makes a volume of more than 200 pages, printed on paper like the Atlas, and uniform with the latter in size. The price will be definitely announced hereafter, when a more full notice will appear.

At the same time will also be published one or two supplementary plates, including one showing the pearls or beading of the *Amphipleura*, for which an additional charge will be made.

Subscribers to the Synopsis will be promptly informed of the time of publication and the price.

#### NOTES.

— We have received two beautiful preparations of plant-hairs from Mr. James E. Whitney, of Rochester, N. Y., who has given considerable attention to them and has a large collection, embracing thirty different forms. The hairs on leaves are often very beautiful objects, and there is such great variety in their form and arrangement that they afford an endless source of delight to the microscopist who undertakes their study. The specimens sent by Mr. Whitney are from *Alyssum saxatile* and *Solanum stacagnifolium* (?).

— The supplementary volume of the *Tijdschrift der Nederlandsche Dierkundige Vereniging* just received contains an extended account of experiments in oyster culture, principally conducted by Dr. P. P. C. Hoek and Dr. A. A. W. Hubrecht. It also contains contributions by other authors to the knowledge of the fauna of the Oosterschelde (a gulf of the North Sea), including the crustacea, bryozoa, coelenterata and protozoa. The latter is by Dr. J. Van Rees, and is illustrated by a plate. The volume is of great value, the more important articles being printed in French as well as in the language of the country. It makes a large book of about 450 pages and 16 plates.

— Dr. L. Younghusband, of Detroit, informs us that he has received a letter from Dr. Koch, of Berlin, accompanied by a mounted preparation of the comma bacillus, which Dr. Koch regards as the cause of Asiatic cholera. It is of interest to know where an authentic preparation of this organism can be found.

— Mr. Van Ermengem has observed that certain bacteria, at the period of sporulation, if treated with staining agents such as are used in staining *Bacillus tuberculosis*, become double stained. In *Bacillus subtilis*, for example, treated by Ehrlich's method, the spores become stained red and the rest blue. Fine and very interesting preparations can thus be made. These facts of double coloration have been previously observed by Bienstock.

— The function of the green coloring matter in the pseudo-chlorophyll bodies of *Hydra viridis* is still unknown. Recent experiments by Von Graff lead to conclusions directly opposed to the supposition that these bodies assist nutrition. Hydras kept in filtered water died after a certain period, apparently from want of animal food. The chlorophyll bodies do not lose their color when kept in the dark, even for a hundred days or longer.

— The February number of *Science Gossip* contains the following announcement:—

'Mr. Wm. Taylor has brought out a simple and clean method of using balsam. It is inclosed in compressible metal tubes, like those containing moist colors, so that the smallest quantity can be expelled at will.'

This will be news to those who have used balsam in this way for a decade or more.

— Some very suggestive observations on the action of pathogenic microbes in the blood have been made by E. Metschnikoff. He found a daphnia affected by a fungus which eventually was fatal in its attacks. By inoculating healthy daphnia he was able to trace the progress of the disease by studying the action of the fungus on the blood-corpuscles. In the first place the spores were attacked by the corpuscles and destroyed. Soon the blood-cells showed signs of injury and some of them burst, setting free gonidia of the fungus. Thus the blood-cells were destroyed, in greater number as the disease progressed. It thus appears that the disease is a struggle between two living



organisms, one the cells of simplest plants, the other the lowest tissue-elements of the animal body. It is easy to draw an inference from these observations, concerning the possible parallelism between the phenomena observed in the case of the daphnia, and the course of certain diseases in higher organisms.

— Mr. W. H. Bulloch is making a portable stand which will fit in a case 9 inches by  $4\frac{1}{2}$  by  $2\frac{1}{2}$ , inside measurements. The base is to be detachable. The stand will have centering substage, with mirror on the substage bar sliding up behind the substage. An Abbe condenser can be used on the stand.

— We have received a preparation of the cholera bacillus from Mr. Woolman, marked 'culture of Dr. Koch,' such as he is now offering for sale. This is a pure culture, very rich in the so-called comma-bacillus. The name comma-bacillus is an unfortunate one, for the slightly curved, and rather short robust rods do not resemble commas very closely, and they seem not to be bacilli at all.

— As is well known the souring of milk is attributed to the growth of a peculiar organism, the *Bacterium lactis*. There is good reason to suppose that the peculiar characters and flavors of the various kinds of cheese are due to the growth of specific organisms. Mr. Earnest Hart, speaking at the London Health Exhibition, said:— 'The milk industry opened up a great field for investigations of this class; it was found that every variety of cheese was due to the influence of a particular kind of minute vegetable organism, which, by its mode of maturation, gave to each cheese its particular flavor and quality; so much so, that one kind of cheese could be made only in one cellar, and another kind in a cellar perhaps 300 yards off, and in none of the intervening cellars could the same kind be made. The last time M. Pasteur was in England with him, he told him that his greatest desire would be, if he had some years to spare, to spend them in the laboratory of a dairy, working out the relation of germs to the milk and cheese industry.'

— We have received some printed notices of recent meetings of the Wellesley Microscopical Society, from which it appears that the Society is active, and that the meetings are as interesting as they were several years ago, when notices were published regularly in these pages. One specimen of considerable interest, dust collected on the barque Wm. H. Bessie

from the eruption of Krakatoa, was shown. The vessel was in the Straits of Sunda twelve or fifteen miles in a direct line from Krakatoa when the eruption began; it soon became too dark to run from the shower of ashes. Being in twenty-five fathoms they lay with anchors down for over forty-eight hours, until it was light enough to see. During most of the time the darkness was so great that at noon the hand could not be seen within a few inches of the eye. The ashes fell in such enormous quantities that all hands were constantly engaged in shovelling it overboard as well as they could in the darkness. The sea was not rough, but a tremendous current was running. This vessel was probably as near the volcano as any that escaped unharmed.'

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## CORRESPONDENCE.

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### Various Subjects.

TO THE EDITOR:—Enclosed please find \$1 to renew subscription; wish it had to be \$2 for a double dose. Last summer I bought an immersion  $\frac{1}{6}$  of Spencer, and asked you for some advice in regard to handling it, and was told to 'go at it.' I have done so, and now go up to No. 19 very well, but am not willing to swear to a good resolution of *A. pellucida* yet. I for one need your long promised article on illumination very much, and pray devoutly that you may soon have leisure for it. I have Prof. E. Smith's celebrated 'How to see with the Microscope,' but have derived more benefit from your single sentence 'go at it,' than from all his highly mixed instructions, down to pulling out table drawer, and putting of napkins on the edge of it.

Last June you answered a question of mine in regard to cementing balsam mounts. I have cemented all my uncemented slides; but afterwards you take it all back, and decide not to cement, so we can tell balsam mounts from others. Would it not be better to cement, and make the label tell the story?

I had great trouble at first from cover breakage. Mr. Ward, in his very interesting paper on mounting, uses the expression 'often breaking cover after cover.' Let me tell you my plan. I think it is handier than your bullet pressure. It is some 25 years ago, when I sent my last bullet adrift, and missed at that. About that time deer took H. Greeley's advice and disappeared from this prairie. I suppose bullets can be found in city gun

stores, but the American clothes-pin, my favorite, blossoms in every country store. I believe it is more readily to be had. After adopting the following plan, I have not lost more than two per cent. of covers. I cut squares of glass a little smaller than the covers, to put on the cover before applying the clothes-pin. This distributes the pressure as evenly as a bullet can; besides the pin forms a convenient handle, quite an advantage in handling slow-drying mounts. I also make the handles do as temporary labels by writing the name of object on them. I enclose the best envelope I have, and shall be much obliged for a little material for mounting. Please command me if I can ever be of service to you, and accept my best wishes for yourself and the new volume. I for one never yet made the acquaintance of the man that pleased everybody and amounted to much himself.

F. DIENELT.

#### Microscopic Specimens about Mobile.

TO THE EDITOR:—During the course of the past year the following novelties for the microscope have been found tributary to Mobile, Ala., by the writer. A limestone or chalk formation from which the microscopic foraminifera may be brushed out in water, or worked into semi-transparent sections; microscopic fossil, resinous pollen-grains; fossil carbonized woods; petrified woods, and wood changed into iron pyrites, found in a seam of Quaternary lignite; fossil sponge spicules and diatoms composing a seam of material of close texture resembling bituminous coal; a dense foraminiferous limestone containing very minute dark foraminifera in a transparent, white, crystalline matrix, very pretty and unique. Dredgings from lower channel, Mobile Bay, furnished spines of minute sea urchins, transparent foraminifera, and various specimens of marine diatoms as *Eupodiscus*, *Triceratium*, etc. A compact Tripoli stone, showing casts of hollow spicules, when examined in very thin sections.

K. M. CUNNINGHAM.

MOBILE, Ala.

### NOTICES OF BOOKS.

*Smith's Diagram of Parliamentary Rules.* By Uriah Smith. Second edition—revised. Battle Creek, Mich.: Review and Herald Publishing Association. 1883. (Price 50 cents.)

This is an invaluable aid to any person

who has occasion to preside over meetings. The diagram is of convenient size for use, and folds in a book containing the key to the diagram, which can be carried in the pocket. On the diagram the relations of various motions to each other are shown at a glance.

*Outline of Vegetable Histology.* By Mrs. William Streeter, President section of botany, R. A. S. Rochester, N. Y.: Davis & Leyden. (Pamphlet, pp. 11, with 5 plates; price 50 cents.)

This is a very concise outline of vegetable histology, which may be read with profit by those who have not time or inclination to take up larger works.

*The Geological and Natural History Survey of Minnesota.* The first annual report, for the year 1872. By N. H. Winchell, State Geologist. Second edition. Minneapolis. 1881. (Pamphlet, 8vo, pp. 130.)

*The Geological and Natural History Survey of Minnesota.* The eleventh annual report, for the year 1882. N. H. Winchell, State Geologist. Minneapolis. 1884. (Pamphlet, 8vo, pp. 220.)

*The Geological and Natural History Survey of Minnesota.* The twelfth annual report, for the year 1883. N. H. Winchell, State Geologist. Minneapolis. 1884. (Pamphlet, 8vo, pp. 196, with numerous plates.)

This volume is of special interest to naturalists since it includes an extended report on Minnesota crustacea, by C. L. Herrick, with a synopsis of the species described in North America and keys to the known species of the more important genera. It is fully illustrated.

There is also a catalogue of the flora of Minnesota by Warren Upham, which is rendered particularly useful by a good index.

### Exchanges.

[Exchanges are inserted in this column without charge. They will be strictly limited to mounted objects, and material for mounting.]

Will exchange very fine unmounted material for single numbers or volumes of MICROSCOPICAL JOURNAL.  
A. LAHR.

73 West 3d St., New York City.

Wanted—A clean copy of the January 1884 number of this JOURNAL; will give mounted slides in exchange, or pay cash

C. M. VORCE,  
Cleveland, O.

Wanted good Diatomaceous material; will give in exchange unmounted *A Pellucida* very pure; or first-class mounts of diatoms.

EDWARD S. NOTT,  
Hamburg, Erie Co., N. Y.



# THE AMERICAN MONTHLY MICROSCOPICAL JOURNAL.

VOL. VI.

WASHINGTON, D. C., APRIL, 1885.

No. 4.

## Abstract from an Article on Intracellular Digestion by Dr. Elias Metschnikoff.\*

BY H. G. BEYER, SURG. U. S. N.

Metschnikoff has long been of the opinion that many questions connected with the genealogy of the Metazoa are not to be solved by the methods of purely morphological embryology, but that in the determination of the phylogenetic importance of any organ, a knowledge of the physiological history is often indispensable. The embryonic history of an animal or organ shows us a series of phenomena, often extremely complicated, among which mere embryology cannot, in many cases, choose out those which are of primitive from those of secondary importance. The difficulties, he says, are increased by the fact that the primitive Metazoa have all disappeared, so that the gap between the Metazoa of to-day and the Protozoa is wide indeed. Thus, in attempting to discuss the evolution of such an organ, as for instance the alimentary canal, one of the oldest and most widely distributed organs of all the Metazoa, one must collect not only embryological evidence as to the mode of formation of the endoderm, but also physiological evidence as to its function.

When it became known that all the lower Metazoa, such as sponges, cœlenterates and turbellarians, possessed an intracellular digestion, the conclusion, of course, was obvious, that this mode of nourishment was one of the few characters in the organization of

the Metazoa which had been directly transmitted to them from the Protozoa, and so constituted a link, however small, between the two groups. Now, since the colonial monads—organisms which most closely resemble the lowest known Metazoa, their embryos and larvæ—show no kind of division of labor, no separation into nutritive and locomotive individuals, the question arose as to whether the lowest Metazoa had not retained the power of using any or all the cells of their body for the purpose of ingesting food. In order to answer this question, Metschnikoff undertook a series of investigations of the results of which we will here give a brief summary.

I. *Ectodermal Intracellular Digestion.*—The sponges being at present the lowest known Metazoa, it seems indeed surprising that Metschnikoff has not been able to discover any ectodermal digestion in them. Repeated researches on *Ascetta primordialis* and *Halisarca lobularis* gave negative results, and thus, although not absolutely denying the possibility of digestion taking place within the ectodermal cells of sponges, Metschnikoff does not think it proved as some would have it. More favorable objects for these researches were found to be the true cœlenterates, and a digestive ectoderm was indeed described in a single one of these before Metschnikoff undertook his researches. Merej-Kowsky, in describing a *Bougainvillea*, in which the alimentary canal was rudimentary, put forward the supposition that in this medusa the food was taken in entirely by the ectoderm, but, not

\* Read before the Biological Society of Washington, March 7th, 1885.

having seen any solid particles within the ectoderm, supposed that it was nourished entirely by organic matter in solution in the sea-water. It has long been known that the ectoderm of hydroid polyps protrudes pseudopodia which frequently anastomose to form a kind of plasmodium, and it occurred to Metschnikoff that these pseudopodia might have the function of picking up food particles. This was really observed to be the case with the nematocalyces of *Plumularia* (*setacea*). When powdered carmine was suspended in the water surrounding a *Plumularia*, it was, after some little time, seen in considerable quantities within the substance of the ectoderm of the nematocalyces. Furthermore, colonies of *Plumularia* polyps, observed in a watch-glass, will only live a short time after gathering; but only the polyp heads die, while the cœnosarc and the nematocalyces survive, which latter may be seen eating up the dying hydranths. Thus, after the polyp has retracted its tentacles and become a mere rounded mass, the free end of a nematocalyx creeps into the theca and gradually absorbs, by means of its ectoderm, the whole contents of the cup. These so-called nematocalyces are therefore classed among organs whose chief function is prophylactic; they eat up necrotic parts of the colony, and also continually explore the organs in this vicinity, in order to render harmless any injurious bodies by devouring them.

Ectodermal digestion has also been observed to take place in *Actinias*, especially *A. mesembryanthemum*. The solid particles contained within the ectoderm are usually seen surrounded by a vacuole, thus indicating the occurrence of some digestive process. If a larval *Actinia* is taken from its mother and placed in water containing carmine in suspension, the carmine granules are eaten by the ectoderm cells, being seized by means of short pseudopodia, extended from the free surface. After the develop-

ment of the gastric pouches, however, the number of foreign particles within the ectoderm is much smaller. As a further example of ectodermal nourishment, Metschnikoff cites the ovarian ova of those animals whose generative cells are ectodermal; for example, those of *Tubularia*, and, according to Kovotneff, of *Hydra*. In the first named, Metschnikoff saw the young ovum eat and digest the neighboring follicular cells, and Kovotneff says that during the winter the young ectoderm cells of *Hydra* devour the older ones.

II. *Intracellular Ingestion and Digestion by Wandering Mesoderm Cells*.—While the taking up of nutriment by ectoderm cells can only be observed in rare and exceptional cases, nothing seems to be easier than to find amœboid cells of the mesoderm which both ingest and absorb food particles. Haeckel was the first to observe that when a *Tethys* was injected with indigo, the granules were taken up by the blood corpuscles. Later on he proved this occurrence in the blood of various invertebrates, and it was this observation of Haeckel which formed the starting point of so many important researches in histology and pathology.

As objects for the study of this function in mesoderm cells, Metschnikoff chose the *Auricularia* of synapta, and the *Bipinnaria asterigera*. At the period of the metamorphosis of these larval Echinoderms, which is, as is well known, extremely complicated, and associated with the loss of many larval organs, these mesodermal cells ingest the cellular debris of the disappearing organs and finally absorb them. Resorption-phenomena can best be seen at two stages in the life history of *Auricularia*. They first occur at the assumption of the so-called pupa stage, when a large part of the longitudinal ring of cilia is lost; that is, is disintegrated and devoured by the mesoderm. At this time every amœboid cell of the mesoderm is generally loaded with enor-



mous numbers of debris-granules which are slowly absorbed during the pupa stage, so that the cells which contained them become filled with clear vacuoles. On the metamorphosis of the pupa into a young synapta, the cells begin again their devouring work, collecting as before beneath the ciliated ring and eating up the products of disintegration. In every case the disintegrating elements break up into albuminoid granules of various sizes which are gradually eaten up and absorbed by mesodermal cells. These appearances have been found to so constantly accompany metamorphosis that they are believed to be normal and necessary events in the life of an Echinoderm larva, and comparable to the appearances exhibited by the osteo-clasts in developing vertebrate bone. This function of the mesoderm is believed to be present in all animals which undergo any great degree of metamorphosis and especially in the complicated larval changes occurring in Ascidians, in which Metschnikoff frequently saw wandering cells loaded with debris. If this should prove to be the case we should have a simple explanation of such appearances as, for instance, the transformation of the degenerating nervous system into a heap of blood-corpuscles, which is at present believed to be due to a direct morphogenetic change in the ganglion cells. Many ovarian ova of *Aurelia aurita* have been observed to become surrounded by amœboid cells and completely devoured. In his early investigation on intracellular digestion in Ctenophores, Metschnikoff saw that carmine-granules suspended in water passed not only into the entoderm cells, but also into those of the mesoderm. In order to study this property of mesoderm cells more extensively, Metschnikoff chose *Bipinnaria asterigeria* and *Phyllirhoë bucephalum*, because these animals are not only transparent, but also large enough to admit of the performance upon them of simple ope-

rations which they are hardy enough to survive. If water holding indigo or carmine in suspension was injected beneath the epidermis of the animal under observation, the portions of coloring matter were after a short time taken up by the amœboid cells. Two different kinds of amœboid cells were found in *Phyllirhoë*—one large, the other small; the smaller ones only ingested coloring matter in this way; the larger ones, although bearing rosy patches, did not contain solid particles. The smaller granules of solid carmine were all eaten by the small cells in the usual manner; the larger masses, on the other hand, were surrounded by a kind of plasmodium of small cells, which approached each lump one by one and flattened themselves upon it, fusing with neighboring cells as these arrived. In this way plasmodia arose of very different sizes, some even large enough to be visible to the naked eye, which might be compared to the giant cells so often described in vertebrates. This certainly confirms the observation so often made by pathologists, that giant cells are often found in the neighborhood of foreign bodies, and long before the discovery of the tubercle-bacillus one of the characteristic microscopical signs of tuberculosis was known to be the giant cell. In all those cases in which Metschnikoff found giant cells in Invertebrates they had arisen around foreign bodies, being always formed by the fusion of separate cells, and not by a process of incomplete fission, as some pathologists hold. Glass-spicules, atoms of dust, or carmine are surrounded and devoured by aggregates of cells in exactly the same way. Metschnikoff thinks it undeniable that the results of the introduction of a glass-spicule or other irritant into the body of an Invertebrate bear no small resemblance to the phenomena of inflammatory exudation in Vertebrates; for certainly, in both cases, a number of mesoderm cells collect around the irritant body and act upon it as best

they may. Therefore, from a point of view of comparative pathology, Cohnheim's dictum, 'without blood vessels, no inflammation,' does not hold; for in *Bipinnaria*, which has no trace of vascular system, we see a gradual accumulation of the numerous amœboid cells scattered throughout the mesoderm. Inflammation is consequently a phenomenon much older, phylogenetically speaking, than blood vessel, while exudation is a comparatively late development. It was one of Cohnheim's leading ideas that inflammation was due primarily to a diseased condition of the vascular walls, and that the migration of leucocytes and the exudation of liquor sanguinis was a direct consequence thereof. The results of Metschnikoff's observations on the resorption during metamorphosis among Echinoderms are moreover in complete harmony with the results of histological and pathological observations on Vertebrates; they have taught us that mesoderm cells are able to take up and to digest albuminoid granules. This conclusion is strengthened by other observations. After the ingestion by the mesoderm cells of *Bipinnaria* of a human blood corpuscle, we see that they are completely resorbed. Within the cell they swell up and become clearer; the hæmoglobin is then dissolved out and finally the whole corpuscle disappears. Milk injected beneath the skin of *Bipinnaria* and *Phyllirhoë* incurs the same fate. If fluids containing bacteria be injected or if they develop spontaneously in the wounds of these animals, they will soon be found within the substance of many amœboid mesoderm cells. Both still and motile forms were thus ingested and found either embedded in the protoplasm of the absorbent cell or surrounded by a vacuole. These phenomena of the ingestion of bacteria by mesoderm cells were most easily seen in *Botryllus*, colonies of which, when freshly gathered, contained almost invariably large quantities of

bacteria. Within this last, Metschnikoff found especially a *Spirochaete* closely resembling the *S. Obermayeri* of relapsing fever, and a small bacillus like the *Lepra-bacillus* which had a spore at each end. Both these forms were pursued by the wandering cells of the *Botryllus* and were found ingested and absorbed by them in various stages of development. The victory was not, however, all on one side; here and there were found mesoderm cells to all appearances dead, with long bacterial filaments projecting from them. Koch has observed *Bacillus anthracis* and the *Bacillus septisæmiæ* within the white blood corpuscles of mice and the *Bacillus tuberculosis* in the interior of giant-cells, so that throughout the whole animal kingdom the wandering mesoderm-cells make use of their ingestive power for the destruction of bacteria and similar organisms. These wandering mesoderm-cells have lately been termed by Metschnikoff phagocytes in connection with an article of his entitled 'The Mesodermic Phagocytes of Certain Vertebrates'; for he has shown that intracellular absorption is also found in the vertebrate mesoderm. Thus, for instance, during the early stages of its absorption, the tail of Batrachians was found to contain a large number of amœboid cells, within which were seen remnants of nerve-fibres and muscle cells. These phagocytes were seen in the living uninjured tail in the case of the *Bombinator* larva, where, at the beginning of the metamorphosis, they collected round the muscles of the tail, the fibres of which were gradually surrounded and devoured. When the atrophy of the gills was in progress it was easy to ascertain the presence of large fully-laden phagocytes. So that phagocytes seem to play a part in the metamorphosis of Batrachians as important as that which they have shown to take in the larval changes of *Bipinnaria* and *Auricularia*.

In order to ascertain whether, in



Vertebrates as well as Invertebrates, the phagocytes had the power of ingesting parasitic bacteria, putrescent blood was injected beneath the skin of the hog, so as to induce septicaemia. After a time the white blood corpuscles were found to contain both still and motile bacteria, each surrounded by a vacuole. The bacteria were found to be especially abundant in the phagocytes of the spleen, which confirms the statement of pathologists that the white blood corpuscles, when they have ingested an insoluble body, are carried into the spleen, indicating the prophylactic function of this organ. Further observations made on the larval triton's tail by touching it with nitrate of silver and noting the phenomena of the ensuing inflammation have led Metschnikoff to regard the cells of the connected tissue as phagocytes, since they act as such during inflammation.

The observations of Metschnikoff confirm those of several investigators who assume an active wandering on the part of the white corpuscles themselves, effected by the protrusion of numerous pseudopodia, similar to those extended by the resting corpuscles of many Invertebrates; this observation is not compatible with the current theory of inflammation, which regards inflammation as primarily due to a morbid condition of the walls of the blood-vessels. Metschnikoff believes that the essence of the whole process is a struggle between the phagocytes and the septic material whether the latter be a dead or dying cell, or a fungus or other foreign body, thus apparently reducing the whole theory of inflammation, whether caused by an injury to a certain part or due to its invasion by living organisms as is the case in infectious diseases, to a microscopic war between phagocytes on the one hand and foreign bodies on the other, and the result of this must be here as elsewhere in nature, the survival of the fittest.

## Staining Tissues in Microscopy.\*-I.

BY PROF. DR. HANS GIERKE.

In 1883 a quarter of a century had past, since the introduction of a method of investigation, that has, more than anything else, assisted to produce the most important results obtained by workers with the microscope in modern times. It is of the greatest use in zoological histology, in the medical sciences, and also, if not quite to the same degree, in botany.

I refer to the treatment of microscopical preparations with dyes which differentiate the elements of structure by the different degrees of affinity between the dye and the tissue, whereby portions thereof are stained in various shades or even in different colors. I would offer this essay on the history and processes of this method of study as a memorial of the twenty-fifth anniversary of its discovery. From imperfect and modest beginnings it has gradually grown into favor, and during the last decade with immense rapidity, so that it is perhaps well to arrest the epidemic ambition of those, especially the younger investigators, who search the copious list of dyes for some material that, either pure or modified, they can warmly recommend for staining, and thereby become an authority. To relate the history of all these methods would make my essay too long, and those which are but repetitions of earlier work will be omitted. With a historical review I shall combine some discussion of particular dyes, and the principles governing their application. Also a list of color-material employed in microscopy, the methods of their preparation and directions for use. I have endeavored in all cases to cite original articles, so that the reader may inform himself thereby. I know well how desirable it is to find the exact manner in which a stain was first applied. Very many hand-books omit to give particulars,

\* From the *Zeitschrift für wissenschaftliche Mikroskopie*. Translated for this JOURNAL by Prof. Wm. H. Seaman, M. D.

and likewise omit to cite authorities, whereby the student might be enabled to search for himself. The metallic impregnation of tissues I have also included, because the object of this operation is the same as staining, to wit, the differentiation of structure, and also because a real coloration sometimes results.

A stranger entering a histological laboratory must be forcibly impressed by the prominence given to staining. Neither the microscope nor the microtome with its menacing knife is so striking to the observer. The clear light everywhere falls upon all the hues of the rainbow. Cabinets full of glowing colors, and tables covered with brilliant stainings, are unexpected revelations. It is true the earnest worker must often bewail and condemn the tedious methods of modern research, but he cannot do without staining for we owe to it extraordinary results in our investigation of animal tissues; in fact, without it our most important discoveries in pathology and histology would be impossible. It is true we are much in the dark as to the exact nature of staining. The chemical reactions involved are not yet so clear but that experience is our best teacher, and we must not confide too much in generalizations respecting our methods.

Nowhere is so much staining done in microscopy as in Germany. The methods in use elsewhere have mostly been carried hither by Germans, or by students educated in Germany. In foreign works on microscopy, for example, in Beale's 'How to work with the Microscope,' manipulation is treated with exhaustive particularity unknown in German books, but methods of staining occupy little space. All important discoveries in this direction have been made by Germans. Even the celebrated French histologist, Ranvier, a master in manipulation, is obliged to content himself with improving our methods.

Gerlach is to be regarded as the founder of this art. His discovery of

the staining power of carmine, and his recommendation of this dye, excited histologists to use it and to experiment further. It is true, colored injections and hardening fluids that sometimes stained to some extent had been previously used; and if carmine-gelatin accidentally retained an excess of ammonia when used as an injecting fluid, the consequent tinging of the tissues adjacent to the vessels by the dissolved carmine could hardly fail to be noticed, and thus suggest staining in mass. Many independent attempts were made to use carmine. The botanists Goppert and Cohn appear to have been the first. (*Botan. Zeitung*, 1843, No. 37.) They added a carmine solution to the cell-contents of *Nitella flexilis* to better study rotation and determine if the chlorophyll masses had cilia, and they remarked that these masses were more deeply dyed than the surrounding fluid. Welcker, in 1858, used carmine for studying the cell-nucleus of muscle-fibres. In England, Lord S. G. Osborne grew plants in carmine solution. He likewise observed the nucleus grew darker than the other elements. More important were the efforts of Hartig for a new method of investigation by staining plant tissues with carmine and other dyes. His results were published at the time Gerlach first turned his attention to carmine as a stain. In connection with Hartig's work that of the apothecary Maschke should be mentioned, published in 1859. Hartig's researches went further than even Gerlach. He showed the tissue must be dead, in order to take the dye, and he observed the same results in plants that Gerlach found in animal tissues. Among the substances used by him were the juice of *Phytolacca decandra*, litmus, black ink, cuprous sulphate, gamboge, and cinnabar. For a time these experiments were fruitless, and so it has come about that Gerlach has received credit as the real discoverer of staining.



Notwithstanding the numerous staining preparations that have been strongly recommended, some of which are useful for special work, such as the net-work of fibrillæ in the gray matter, carmine is, in my opinion, the best material for showing white nerve substance, branching cells, and neuroglia. This dye is obtained from cochineal, which is the dried female of a scale insect first found in Central America. It is now cultivated wherever the cactus on which it feeds will grow. The insects are boiled in a solution of certain salts, as alum or saltpetre. Each maker has his own method, but only the very best brands are suitable for microscopy, that known as 'Nakarete' being the best. The cochineal solution is allowed to stand until the carmine precipitates, when it is dried in cakes. Chemically it is carminic acid with the formula  $C^{17} H^{18} O^{10}$ . It is not soluble in water, but combines with ammonia and acetic acid, the first compound being the most often used in staining. To set cure the best results a strong solution should be kept in stock; that which is freshly made seldom works so well, and may contain free ammonia to its injury. I pulverize the commercial cubes, add water and sufficient ammonia to dissolve it. I then allow it to stand several days in an open vessel; then filter. This concentrated solution I keep for about two years in corked bottles before using if possible. All the ammonia will disappear—part by absorption of carbon dioxide, part by evaporation. The presence of ammonium carbonate is very advantageous; it acts as a mordant. One of the chief advantages of carmine is that it works well whatever the previous treatment of the preparation. Chromic acid has been said to be incompatible, but it is not so unless too strong, and for brain sections is better than alcohol, the use of which for them should be avoided even to moisten the knife. Ammoniacal carmine is the most permanent dye

known; if properly used it never fades. I have seen some of Gerlach's preparations of the spinal marrow twenty-five years old, that appeared to be unchanged. None of the numerous colors that have been tried are entirely satisfactory in this respect. Gold preparations darken, vegetable dyes fade, though Hematoxylin with alum as a mordant is the most desirable after carmine. In 1856 a new class of dyes was introduced, the anilines, that worked a revolution in dyeing. The first was Mauvein; in 1858, Hofmann discovered anilin red, and many others soon followed. Waldeyer was the first to apply these in histology; he used rosanilin, anilin violet and anilin blue. But the anilin colors have not found favor yet as important stains. Thiersch, in 1865, recommended indigo-carmine and Chrzonszczewski found it especially suitable for injecting the tubuli of the liver and kidneys.

About this time a great step forwards was made, viz., double staining. Picric acid and carmine were used separately by Schwarz for this purpose, and the publication of his peculiar methods in 1867 undoubtedly led Ranvier to the idea of combining the two and making picrocarmine, which remains one of our choicest stains. A species of double staining was however known before Schwarz, made by impregnating tissues with metals, then dyeing in carmine. Also Schulze and Rudneff in 1866 used osmic acid to darken sections subsequently treated with carmine. This brings me to another branch of the subject, viz., impregnation with metallic salts, which is quite as useful as staining, and has been entirely worked out since 1860.

The following historical synopsis of literature on staining in Microscopy contains all the important original works, essays, and notices on our subject. Those which are simply repetitions or recommendations of earlier work are omitted.

Foreign methods find a place only so far as they have been published in works known in Germany, but I think but little has wholly escaped us, and corrections and additions will be gladly received.

[*To be continued.*]

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### Provisional Key to Classification of Algæ of Fresh Water.—I.

BY THE EDITOR.

The classification of the algæ of fresh water is still in a very unsatisfactory condition, when viewed from a scientific standpoint, for the reason that there still remains so much to be learned about the methods of reproduction and development. No doubt the only scientific classification possible must depend, to a greater or less extent, upon the methods of sexual reproduction. Not that these processes as observed will serve as a universal and only indication of the relationship or differentiation of families, genera and species, but that they must form a basis of classification which shall bring together forms that are genetically connected. It is not sufficient to know how reproduction in a given plant is effected, but it becomes also necessary to know the significance, in the genetic history of the plant, of the phenomena observed. For example, in the family zygnemaceæ there are various processes of conjugation between neighboring cells. It becomes necessary to trace this method of conjugation downward until we can discover its most primitive manifestation, and then to follow its various modifications, until we can determine the course of its development. We shall then be able to understand the true relation between the different genera of the family, and also to assign the family itself to its proper position among the other families of algæ. At present this is not possible; and whoever attempts to improve upon the classification already sanctioned by continued usage, if by no greater

authority, must be prepared to devote years of constant study to the work.

It is no new system, therefore, that will be brought forward in these articles. We cannot even promise that they will be in all respects fully up to the times, for much of the literature which we would wish to consult is not at present available. However, the work is offered in the belief that it will prove useful to many readers who are sometimes puzzled to make out the distinctions between the genera as usually described in books. Distinctions which those who are familiar with algæ recognize immediately—by what seems a kind of intuition, but is really the result of familiarity with the different genera which permits one to instantly recognize many of them at a glance—are not readily picked out from the descriptions usually given. It is to aid those who are not acquainted with the subject that this work is compiled from notes and observations made by the author in the course of reading as well as in the study of fresh specimens. It does not purport to be more than a provisional key—a sort of original draft to serve as an outline and guide for future work of a more thorough and comprehensive character.

It is only after long consideration that we have concluded to follow, in a general way, the arrangement of Rabenhorst's 'Flora Europæa Algarum.' This we have decided to do in view of the fact that it will doubtless be more readily used by the beginner in this study, having reference to either Rabenhorst's work, or to the beautifully illustrated work 'British Fresh-Water Algæ' by M. C. Cooke, than any more scientific system that might be proposed.

The system serves very well for the study of the fresh-water species by themselves, but when it is desired to study the algæ as a whole, including the marine forms, and to indicate the systematic position of algæ among the cryptogams, it is far from satisfactory.



The desmids and diatoms are not regarded in this classification, the former having been adequately treated by Mr. Wolle, and the diatoms by various authors.

The colored protoplasm of the cells of algæ is known as the endochrome. The color is due to chlorophyll, which may be either pure (green), or mixed with other coloring matters such as a blue (phycocyanin), a red phycœrythrin, a brown (phycophærin), which impart to it various shades of color. The colors afford a means of distinguishing several classes which have received corresponding names, thus we have—

1. Chlorospermæ, Harvey; Chlorosporeæ, Thuret; Chloro phyllophyceæ, Rabenhorst. Green, chlorophyllous algæ.

2. Cyanophyceæ, Sachs; Phycochromaceæ, Cohn; Phycochromophyceæ, Rabenhorst. Bluish-green algæ.

3. Melanospermæ, Harvey; Melanophyceæ, Rabenhorst; Phæosporeæ, Thuret. Olive-green, brown or blackish algæ.

4. Rhodospermæ, Harvey; Rhodophyceæ, Rabenhorst. Red algæ.

By far the greater number of algæ found in fresh water belong to the first two classes, a few belong to the third. All the red algæ are marine.

The separation of the algæ into classes founded upon the coloring matter within their cells is too purely artificial to form basis of a scientific classification. We have only partially adhered to it in this place, and that merely as a matter of convenience; but it separates many species that are unquestionably closely related, and which should be placed in the same genera. Thus, there is not the slightest doubt that various forms of unicellular algæ such as *Glæocapsa* and *Glæocystis*, for example, are genetically connected, yet some are green and others are olive-green.

Many of the divisions of families and descriptions of genera are taken

largely from Kirchner's work, although the arrangement is not entirely the same, and Rabenhorst's and other works have been carefully studied in the same connection.

The descriptions are limited to the genera, since it would enlarge this work too much to include descriptions of species.

The writer would be very glad to receive suggestions from persons using this key, which will enable him to improve upon it in future; and he would be especially grateful for corrections of errors that may be found in it.

#### I. ORDER PROTOCOCCOIDEÆ Kirch.

Unicellular algæ, of chlorophyll-green color, propagating by swarm-cells. Without terminal growth, not branching.

The thallus of these algæ consists during their entire life either of a single cell, or else the single cells remain united in a more or less close parenchymatous-like combination, still indicating in this case their unicellular character since in each of the cells all vegetative and reproductive processes take place.

Propagation either sexual, by oogonia and antheridia, or by copulation of swarm-spores.

Cell-contents chlorophyll-green (very rarely reddish yellow or brown), never bluish green.

#### FAMILIES.

Propagation by swarm-spores, and cell-division. The single cells either free or united by a gelatinous matrix, stems, etc. Copulation of swarm-spores not observed.

##### PALMELLACEÆ, I.

Vegetative cells not ciliated, either single or in cœnobia. Propagation by copulation of swarm-cells and by asexual zoospores. No vegetative cell division. PROTOCOCCACEÆ, II.

Vegetative cells during their entire life motile. Reproduction sexual, or asexual by copulation of swarm-cells. VOLVOCEÆ, III.

*Family I. PALMELLACEÆ Kirchner.*

Cells single, free or united by a gelatinous envelope, connecting stems, etc., into large or small, mostly slimy or gelatinous, families.

Reproduction by vegetative cell-division and formation of zoogonidia. Copulation of zoogonidia has not been observed in this family.

a. Single cells, separate, or not forming definite families. (SEPARATÆ.)

*Synopsis of Genera.*

Cells single, spherical, floating; envelope thick. *Eremosphera*, 1.

Cells separate in small, indefinite families; envelope thin.

*Pleurococcus*, 2.

Cells oblong; floating, or attached by hyaline pedicel. *Dactylococcus*, 3.

Cells oblong, single or in rows.

*Stichococcus*, 4.

Cells cylindric, straight or curved; in series end to end or bundles.

*Raphidium*, 5.

b. Cells united in families by the envelope of the mother-cell enclosing the daughter-cells. (INCLUSÆ.)

*Synopsis of Genera.*

Cells distributed in large, gelatinous, spherical families. *Botrydina*, 6.

Cells oval; in botryoidal, lobed families.

*Botryococcus*, 7.

Cells enclosed in globose, lamellose envelopes.

*Glæocystis*, 8.

Cells red, on thick gelatinous stalks of concentric lamellose structure.

*Urococcus*, 9.

Cells kidney-shape, lying separate in ample, gelatinous envelope.

*Nephrocytium*, 10.

Cells oblong, in common gelatinous envelope.

*Oocystis*, 11.

Cells oval, with large, colorless vacuole; in common, gelatinous envelope.

*Glæococcus*, 12.

c. Cells united in families of characteristic form by the formation of slimy and confluent envelopes. (GELATINOSÆ.)

*Synopsis of Genera.*

Cells oval, in tubular, branched, gelatinous thallus. *Hydrurus*, 13.

Thallus globose, eight-celled, floating. *Chromophyton*, 14.

Cells in hyaline, cylindrical, single or radiately arranged envelopes.

*Palmodactylon*, 15.

Cells longitudinally arranged in tubular hyaline thallus.

*Hormospora*, 16.

Cells in hyaline envelopes, the latter joined into a long thallus.

*Palmodictyon*, 17.

Cells distributed in a hyaline thallus attached by a pedicel-like base.

*Apiocystis*, 18.

Cells in oval transparent envelopes in a globose, hyaline thallus.

*Entophysalis*, 19.

Cells distributed, often in twos and fours, in a gelatinous layer.

*Tetraspora*, 20.

Cells cubical, angular, in tubular families.

*Staurogenia*, 21.

Cells oval, in longitudinal series in gelatinous thallus. *Inoderma*, 22.

Cells in gelatinous families, integuments splitting in halves and quarters remaining in the gelatin.

*Schizochlamys*, 23.

Cells green, red, or orange, thick walls; indefinite gelatinous thallus.

*Palmella*, 24.

Cells spherical or angular, red or purple, in layer of gelatin.

*Porphyridium*, 25.

d. The single cells are united in families by the formation of pedicels or fine stems. (STIPITATÆ.)

*Synopsis of Genera.*

Cells elliptic, on ends and at axes of dichotomous, hyaline stems.

*Cosmocladium*, 26.

Cells terminal, on stems.

*Mischococcus*, 27.

Cells terminal, on very delicate stems, in spherical hyaline thallus.

*Dictyosphaerium*, 28.

Cells in fours, on very short branching stems. *Dimorphococcus*, 29.

Cells on radiating gelatinous stems



of a hard, crustaceous, greenish thallus.

*Oocardium*, 30.

Genera of doubtful value, omitted in this classification:—

*Tachygonium* Nägeli.

*Palmophyllum* Kützing.

#### a. SEPARATÆ.

##### 1. Genus *Eremosphæra* De Bary.

Cells spherical, free-swimming; walls thick, firm, hyaline; contents green, granulose, sometimes radiating in laminae or plates from the centre of the cell.

Propagation by division into 2-4 daughter-cells, each of which escapes by a special rupture in the cell-wall. Zoogonidia not known.

##### 2. Genus *Pleurococcus* Kirchner.

Cells spherical, or polyhedral through mutual pressure, with thin, not confluent walls, single or in small spherical or cubical aggregations; contents green, red, or reddish-yellow. Division in every direction.

Propagation by gonidia, not observed in all species.

##### 3. Genus *Dactylococcus* Nägeli.

Cells oblong or spindle-form, free swimming, with thin walls, forming families of 2-8 cells by oblique division, the cells finally separating and becoming single. Contents green, with one starch granule.

[The cells of *Dactylococcus* are enclosed in ample hyaline sheaths, which are stipitate, or attenuated into a pedicel which is attached to some object. *D. De Baryanus*, for example, is parasitic on small aquatic crustaceans, such as entomostraca.]

##### 4. Genus *Stichococcus* Nägeli.

Cells oblong, or short-cylindric through mutual lateral pressure, with thin walls; single or joined serially into small, free-lying families; contents green; division only in one direction.

##### 5. Genus *Raphidium* Kützing.

Cells fusiform, cylindric or needle-shape, ends usually cuspidate or acuminate, straight or curved; single, or two joined end to end, or in fascicles or bundles; walls thin; contents

green, with a central or rarely lateral vacuole. Division perpendicular to the longer axis.

#### b. INCLUSÆ.

##### 6. Genus *Botrydina* Brébisson.

Cells spherical or oblong, with thick, gelatinous, partially confluent integument, associated in families, sometimes very large, closely surrounded by the expanded membrane of the original mother-cell, which constitutes a sub-globose thallus. Contents green.

##### 7. Genus *Botryococcus* Kützing.

Cells oval or elliptical, with thin walls, united in a small solid, botryoidal family (like a bunch of grapes), which is very closely enveloped by the thin, different membrane of the original mother-cell. Contents green, reddish or brownish.

##### 8. Genus *Glæocystis* Nägeli.

Cells globose, with gelatinous envelopes; single or 2, 4-8 associated in globose gelatinous families; special and general envelopes lamellose. Contents green, with a starch-granule and a vacuole, rarely red. Division in alternate directions.

Propagation by motile gonidia.

[The peculiar lamellose structure of the gelatinous matrix distinguishes this plant from *Pleurococcus*.

We are inclined to place the very closely allied *Glæocapsa* in this family, particularly since the observations of Paul Richter\* tend to prove that *Glæocapsa* and *Glæocystis* are the same plant under different conditions of growth. Both these genera are found in moist situations, exposed to the air, but never under water, since in water their gelatinous investments disappear.

The beginner may be puzzled at times to distinguish between the two genera. In a general way it may be said that the lamellose structure is more distinct in *Glæocystis* than in *Glæocapsa*, and the former is usually green, while the latter is olive or bluish-green. Some species

\* See this JOURNAL, vol. ii, pp. 25 and 52.

of *Glæocystis*, however, are brownish or yellowish.

We have, however, followed Kirchner in this classification, placing *Glæocapsa* in the family Chroococcaceæ, in the order Schizosporeæ.]

9. Genus *Urococcus* Hassall.

Cells globular or oblong, large, reddish or blood-red, with a thick gelatinous, concentrically laminated envelope, which forms a thick, annularly streaked, apparently articulated, gelatinous stem, which may have a branching character, with the red cells embedded in the ends.

10. Genus *Nephrocytium* Nägeli.

Cells kidney-shaped, 2, 4, 8, or 16 lying separate in ample kidney-shaped or oval, free-swimming bladders (of the mother cell-wall); contents green, with a starch-grain and a vacuole.

Propagation unknown.

11. Genus *Oocystis* Nägeli.

Cells oblong, single, or 2, 4, 8, in the extended, oblong mother-cell; contents green.

[This genus differs from *Nephrocytium* only in the oval and not reniform shape of the cells.]

12. Genus *Glæococcus* A. Braun.

Cells oval, green, with colorless vacuole, enclosed in ample gelatinous envelopes, which are united into a common thallus.

Propagation by zoogonidia, with two cilia, produced in the last generation of cells.

c. GELATINOSÆ.

13. Genus *Hydrurus* Agardh.

Cells spherical or elliptic, with thick, gelatinous, confluent envelopes, forming a large tubular or worm-like, often branched, attached, gelatinous thallus, sometimes 3 dm. long; contents green or brown, cells often colorless at the end. The zoogonidia form single in each mother-cell.

14. Genus *Chromophyton* Woronin.

Thallus globose, pulveraceous, eight-celled, floating at surface of water.

[The genera *Hydrurus* and *Chro-*

*mophyton* are described by J. Rostafinskię\* under a new family, Syngeneticeæ, sub-family Chromophytoneæ, which includes only these two genera. They closely resemble each other, the principal difference being in size and form of the thallus. This author regards the plant as belonging to the Phæoideæ, a new division established by himself, nearly identical with De Bary's Phæophyceæ.]

15. Genus *Palmodactylon* Nägeli.

Cells spherical, with thick, vesicular or confluent cell-walls, enclosed in floating, cylindrical vesicles usually radiately arranged. Cell-contents green.

Division at first in one direction, later in all directions.

16. Genus *Hormospora* Brébisson.

Cells oblong, arranged in longitudinal series, in tubular thallus, simple or branched; floating free. Cell-contents green, with a starch-grain at one side. Division only in one direction.

[This genus is a doubtful one, since it is probably a condition of dissolution of certain filamentous algæ.]

17. Genus *Palmodictyon* Kützinger.

Cells spherical or oval, with thick gelatinous envelopes, one or several cells within single envelope of mother-cell. Gelatinous envelopes connected into a subreticulate or filiform anastomosing thallus.

Propagation by motile gonidia.

18. Genus *Apiocystis* Nägeli.

Cells globose, scattered or 8 disposed in a circle, embedded in a small gelatinous thallus which is attached by a stem-like base. Cell-contents, homogeneous or firmly granulose, with a distinct chlorophyllous vesicle and colorless vacuole. Tegument thick, dissolving to a homogeneous jelly. Division in every direction.

Propagation by motile gonidia, globose, with two cilia.

19. Genus *Entophysalis* Kützinger.

Cells rotund, associated in families surrounded by elliptical mother-cell. Thallus globose, cartilaginous, including the families of cells.

\* *Hydrurus* i jego Pokrewienstwo. Kraków, 1882.



20. Genus *Tetraspora* Agardh.

Cells spherical, with thick diffuent walls, distributed without order, or in twos and fours, in a large, one-layered gelatinous thallus, originally sac-like, afterwards open. Walls of the mother-cells after division disappear. Cell-contents green, usually with distinct starch-grain. Division in different directions, in the same plane.

Zoospores with two cilia form singly in the cells.

21. Genus *Staurogenia* Kützing.

Cells of cubical or angular form, lying in a plane, united in table-like, free swimming families of 4-8-16 cells. Division in two directions, at right angles.

Propagation by still gonidia.

22. Genus *Inoderma* Kützing.

Cells oblong; arranged more or less in longitudinal series loosely connected with soft gelatin, tegument thick, diffuent; constituting a gelatino-membranaceous, irregularly expanded, or pseudo-filamentous thallus. Division in one direction only.

Propagation by motile gonidia.

23. Genus *Schizochlamys* A. Braun.

Cells globose or ovate, single or united in gelatinous families like *Tetraspora*. Tegument of mother-cell separating in 2-4 equal parts, by splitting into halves or quarters. The pieces remain embedded in the common jelly for a long time.

Propagation by micro- and macro-gonidia.

24. Genus *Palmella* Lyngbye.

Cells spherical, with green, red or orange colored contents, and thick confluent walls, which produce a structureless, gelatinous layer. Division in all directions. Thallus without definite form.

[The palmellæ are doubtless for the most part stages in the development of higher algæ.]

25. Genus *Poryhrydium* Nägeli.

Cells spherical or angular from mutual pressure, with rather thin diffuent integument, united in families of a single (rarely double) layer of cells.

Cell-contents red or purple. Division in different directions of the layer.

[This genus is included among the Rhodophyceæ by Rabenhorst, but it is evidently very closely related to *Palmella*.]

## d. STIPITATÆ.

26. Genus *Cosmocladium* Brébisson.

Cells elliptic or kidney-shape, on the ends and axes of dichotomously branched, hyaline stems, the entire family having a tree-like appearance. Cell-contents green, with a starch-grain. Division only in the direction of the stem.

Propagation by zoospores, 4-8 of which form in a mother-cell.

[A new genus *Hauckia* Borzi, is very closely related to *Cosmocladium*; but we are not now able to give its distinctive characters. See *Brébissonia*, 1881, p. 97.]

27. Genus *Mischococcus* Nägeli.

Cells globose, terminal, two or four in rows on the ends of dichotomously branching, very delicate, hyaline thallus.

Propagation by zoogonidia.

28. Genus *Dictyosphærium* Nägeli.

Cells elliptic or kidney-shape, with thick, diffuent walls, united in free-swimming spherical, hollow families, single cells on the ends of slender filaments which radiate from the centre of the family and repeatedly branch toward the periphery. Cell-contents green, with a starch-granule and a peripheral vacuole. Division at first in all directions, later only radially.

29. Genus *Dimorphococcus* A. Braun.

Cells in fours on very short branches, dissimilar, the two intermediate ones contiguous, oblique, reniform or obtuse ovate, the two lateral ones opposite and separate, lunate. Families free-swimming, forming botryoidal clusters.

30. Genus *Oocardium* Nägeli.

Cells subovate, slightly emarginate at the ends, stipitate, with central chlorophyll vesicle, often with a

colorless vacuole. Thallus crustaceous, hard, verrucose, pale green, radiately striate within. Cells borne singly or in pairs on gelatinous stems, tubular, di- or tri-chotomously branched, fastigiate, densely compacted, calcareous. Division alternately in two directions.

[To be continued.]

### Pollen-tubes.

The number of the *Journal* of the New-York Microscopical Society of January, 1885, contains an account of the proceedings at their meeting of November 21st, and also a paper read by Mr. N. L. Britton, to which he gives the title, 'Criticism on Mr. J. Kruttschnitt's Papers and Preparations relating to Pollen-tubes.'

Mr. Britton's remarks can scarcely be taken as a criticism; they seem to be rather intended as a hint that an amateur worker in a science should not annoy the professors thereof by persistently calling into question the infallibility of their dogmas and their teachings.

I am not inclined to take the hint, notwithstanding the formidable array of heavy artillery brought to bear against me. I will not haul down my colors; I will only do so on condition that Mr. Britton, or any one else, produce a preparation in which the pollen-tubes as they are emitted on the stigma of any angiospermous plant may be traced down the style to the ovarian cavity and to the micropyle of the ovules. This should not be a difficult task, considering what Mr. C. R. Barnes, professor of natural history at Purdue University, La Fayette, Ind., says on this subject. In a letter received from him on the 22d of May last occurs the following: 'There is a plant in which you can easily see the entrance of the pollen-tubes into the micropyle, that is, if you are as successful as my students usually are. That plant is *Capsella Bursa-pastoris*.' I sent him some of my preparations, requesting him to send me some of his; in answer he

writes under date of June 4th: 'I am just now in the very busy time of commencement, but as soon as that is over I shall send you a slide showing the entrance of the pollen-tube into the micropyle of an ovule of *Capsella*. They are so easily gotten when wanted that I have never thought worth while to make a permanent preparation.' So far Prof. Barnes has not redeemed his promise; I, however, in the interval, have made a number of preparations, in fact, I have subjected *Capsella* to a most thorough examination in the various phases of development of its ovaries, but have failed to discover anything having the appearance of a pollen-tube, such as the pollen-grains of certain plants emit on the stigmas. I am therefore at a loss to imagine to what structure Prof. Barnes attaches the significance of a pollen-tube, unless he take as such the vascular fibre in the funiculus.

The difference of opinion concerning the fecundation of the ovules refers apparently to the functions which are attributed to the conducting tissue. All admit that the conducting tissue performs a part herein; some assign it only a subordinate one, making it the carrier of the pollen-tubes towards the micropyle, whilst I consider it the principal factor, in as much as it diffuses the fertilizing element of the pollen all over the whole ovary in its entirety to the extent of its ramifications. Mr. Britton, on the authority of Mr. Sachs, says: 'The pollen-grains which germinate on the stigma send out their tubes through the channel of the style, where there is one, or more frequently through the loose conducting tissue in its interior down to the cavity of the ovary.'

The examination of the style and of the ovary of *Cereus grandiflora* shows unmistakably the functions assigned in this plant to the conducting tissue. The pollen-tubes, after their emission on the stigma, insinuate themselves amongst the papillæ of the stigma where their contents, the



fovilla, are discharged and taken up by the conducting tissue of the style. If the style be torn open and the fibrillæ of the conducting tissue separated, the fovilla in it is easily traceable all along in streaks and blotches down to the ovary. Here the conducting tissue spreads itself out over the walls of the ovary and the placenta, accompanies the funiculi to their junction with the ovules. The tuft of papillæ surrounding the micropyle of the ovule, which on bending round on its long funiculus is brought in easy contact with the minute papillæ which beset its ventral portion, the fertilizing element is absorbed; thus also communicated to the oosphere in the embryo sac and the process of fertilization is accomplished.

According to Mr. Britton the number of pollen-tubes depends on the number of ovules, and he says the former are generally in excess of the latter. The ovary of *Cereus grandiflora* contains at least 3,000 ovules; the style is a tube about 8 inches long and has a very small channel; the fibrillæ of the conducting tissue, which are also tubular, fill up the body of the style; more than 3,000 pollen-tubes must therefore seek their way down to the ovary. Such a mass of foreign material in the style should certainly leave a trace behind; but I have never discovered any. Transverse sections of the style before and after pollinization are similar in appearance, but the style on being laid open longitudinally after pollinization contains plenty of fovilla granules throughout the conducting tissue.

Mr. Detmer, in a paper also cited by Mr. Britton, has undertaken to trace the course of the pollen-tubes in angiosperms; I have corresponded with him and also with Mr. Strasburger on this subject, pointing out to them the impossibility of pollen-tubes reaching the micropyle of the ovules in certain plants in the way indicated. I submitted them also some of my preparations; but our correspondence remained without result,

the gentleman named first having not the leisure to re-examine into the question.

In September, 1883, I exchanged also a few letters with Mr. Britton concerning pollen-tubes. On that occasion he mentioned also the fortuitous experience he met with in *Cypripedium acaule*, the same as he mentioned in his paper; by not alluding to any other observation of his own in support of his criticism, one might be induced to draw the inference that with this casual and superficial observation in the field, his researches after pollen-tubes have been exhausted.

I have also observed more than once bundles of fibres like a skein of silk filling the style, of which Mr. Britton speaks; but the idea never occurred to me that they were pollen-tubes. I took them for a bundle of fibrillæ of the conducting tissue, which, in the wall of the ovary, run down in the rear of the placenta and in close proximity of the ovules. I have prepared a slide showing this very plainly. The material is from an *Orchis*.

The slide of *Monotropa uniflora*, which, at the same meeting of the New York Microscopical Society, became the subject of a magic-lantern exhibition, was kindly loaned to me by Mr. Joseph Schrenk also in 1883. On returning it I took occasion to mention that the fibre seen to approach the micropyle of one of the three or four ovules the slide contains, was not a pollen-tube, according to my conception, but a branched fibre of the conducting tissue, and my more recent investigation in *Monotropa* would not allow me to change my opinion in this respect.

Angiospermous plants with orthotropous ovules would offer the greatest facility to fecundation by means of pollen-tubes, but these are only of limited occurrence; plants, on the contrary, having anatropous ovules comprise the largest number, and these would offer also the greatest

difficulties if not absolute impossibilities to fertilization by this process. If the pollen-tube theory be ignored the fecundation of every single ovule in whatever position it be attached to its funiculus or to the placenta would be easily accomplished in the most simple and natural manner by reason of such position or attachment. Nature chooses always the most simple means to accomplish its ends; it has never been found to have placed obstacles in its own path; where we think to have discovered them, they are only the children of our imagination or of a misinterpretation of appearances.

In conclusion I will say that as Mr. Britton considers it necessary in the interest of science to warn the amateur student not to allow himself to be led astray by my heretical notions, he would have rendered a much greater service to science by encouraging that class of workers to examine for themselves, instead of counselling them to imitate the example set by the professors of the science and to believe blindly in what is offered by others as Gospel truth.

J. KRUTTSCHNITT.

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## EDITORIAL.

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**Publisher's Notices.**—All communications, remittances, exchanges, etc., should be addressed to the Editor, P. O. Box 630, Washington, D. C.

Remittances should be made by postal notes, money orders, or by money sent in registered letters. Drafts should be made payable in Washington, New York, Boston, or Philadelphia.

Subscription-price before April 1st, \$1 per year, in advance. All subscriptions begin with the January number. After April 1st the subscription-price will be \$1.50.

The regular receipt of the JOURNAL, which is issued on the 15th of each month, will be an acknowledgment of payment.

The first volume, 1880, is entirely out of print. The succeeding volumes will be sent by the publisher for the prices given below, which are net.

Vol. II (1881) complete, \$1.50.

Vol. III (1882) complete, \$2.00.

Vol. IV (1883) complete, \$1.50.

Vol. V (1884) complete, \$1.50.

Vol. V (1884), Nos. 2-12, \$1.00.

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**MICROSCOPICAL SOCIETIES.**—We desire to publish a complete list of the microscopical societies in the country, with the dates of their organization, number of members, and

names of their present officers. We would also like to have information concerning their membership, condition, and prospects. It has been suggested that the list should be revised each year, so as to be a record of the societies in existence.

We therefore request the secretaries of microscopical societies to favor us immediately with the information desired that we may soon be able to publish the list for this year. We would be pleased to receive copies of constitutions or rules of the societies for reference. To ensure the proper entry in the list, it is earnestly requested that secretaries do not delay sending the desired information. We cannot possibly know all the societies in the country, and if any are left out of the printed list it will be due to the neglect of the officers who are able to give the information.

—o—

**STAINING TISSUES.**—The first of the series of articles which Prof. W. H. Seaman has undertaken to translate for this JOURNAL, published this month, does not give a very good idea of the practical value they possess. This part is introductory to the most exhaustive study of the staining agents used in microscopy that can be imagined, it is an invaluable work for reference, giving as it does a brief statement of the materials used, their method of preparation, and their special applications, with references to the original descriptions of processes.

The article is not confined to dyes used for animal tissues, but it treats of colors used in all branches of microscopical investigation. All who have occasion to do staining of tissues, of whatever kind, will find this article of the greatest use, and our readers are much indebted to the translator for devoting so much of his time to the subject.

The subject will be continued from month to month, as it necessarily occupies a considerable space on these pages.



**MICROSCOPICAL EXHIBITIONS.**—The ostensible purpose of public exhibitions given by microscopical societies is to promote interest in microscopical studies. As usually conducted they bring together a large collection of attractive objects, chosen mainly because they are of a striking character, well calculated to arrest attention and produce astonishment in the minds of the uninitiated. While we do not wish to write one word of opposition to such displays, which are undoubtedly very desirable and instructive, we were led to think, on the occasion of the recent exhibition in this city, whether there could not be devised some means to make them far more useful, from an educational point of view.

A plan very soon came to mind, which at the time seemed practicable, and has since commended itself more perfectly; we now offer it for consideration to our readers, some of whom may feel disposed to try it. It is this: Instead of asking all the members of a society to select their own objects for exhibition, which results in a promiscuous collection without any pretence of systematic arrangement, let some member, or several members acting together as a committee, take charge of the entire exhibition and select one or more series of objects to be shown in their proper order, to illustrate certain subjects. The list of objects once made out, it will be a very easy matter for any person familiar with the tastes and abilities of the members to assign the objects around to the satisfaction of all.

The purpose of such an arrangement is to make exhibitions instructive in the highest degree possible. To more fully explain our meaning let us take a special subject for present consideration, premising, however, that we have not given it sufficient consideration ourselves to offer a scheme in any sense complete or satisfactory concerning any subject. We will suppose, then, that there are fifty microscopes available for an ex-

hibition, and it has been decided to devote a number of them to the illustration of the process of fertilization and early development of plants. The first object shown should be a drawing or painting of a flower, designating the filaments, anthers, ovaries, etc., so that subsequent explanations may be understood. Then, beginning with the microscopes, some varieties of pollen might be shown, followed by a preparation showing the growth of the pollen-tubes. Next there should be some sections of ovaries of different plants, showing the various positions in which the young seeds grow within them, and other features that will occur to an observer. Then there might come some ripe seeds of various kinds, showing the ornamentation upon many of the common flower and vegetable seeds, and finally sections of the ripe seeds showing the young plant in embryo. Each specimen should be clearly described, as concisely as possible, so that the observer can immediately understand it. The plan of describing every specimen in order on a printed program, adopted by the New-York Microscopical Society, would be excellent for an exhibition of this kind. Out of fifty microscopes, twenty might be devoted to one series of objects, twenty to another series of a different kind, and the remaining ten to the standard show-specimens, such as the circulation of blood, cyclosis in a plant, beetle's wings, and gorgeous objects of all kinds.

This hastily drawn outline will be suggestive to those who deem the plan worthy of trial. It appears to us it would add greatly to the interest of such exhibitions, and benefit not only the guests but also the members themselves. It would certainly make it necessary for members to prepare special objects for such an exhibition and to read up on the subjects assigned to them—a proceeding that could not fail to be beneficial.

At the present time society exhibitions are not in great favor among

men of science because there is not much to be learned from them. The average exhibitor has but a very superficial knowledge of the specimens he shows—a fact very easily discovered by an inquisitive guest. This should not be so, and hardly could be if the spirit of these suggestions were carried out. If persons attend exhibitions of the kind to pick up scraps of knowledge here and there, certainly the exhibitors should at least read up about their own objects, and be ready to tell something about them.

We would be glad to receive communications and suggestions from readers concerning the subject, as it is one of universal interest.

—O—  
**POSTAL CLUB BOXES.**—Box I came into this circuit Feb. 9th an empty box, to be filled. The new headings of the letter packet are a great improvement over the old. The printed form calls for common and scientific name of the object, how prepared, mounting medium, cell and cements, objectives advised for examination, and history or description of the object.

We have put in a slide of *Chroolepus aureus*, one of the aerial algæ, collected in 1882 in Watkins Glen, New York.

Box B<sup>2</sup> reached this circuit on the fifth of March, with the following preparations:—

1. Sections of seeds of *Cucurbita melopepo*, squash. Rev. A. B. Hervey. The sections of the seed are quite interesting for study. Four layers are described, viz:—

1. Large reticulated cells.

2. Lignified cells, two layers.

3. Small reticulated cells.

4. A very much thicker layer of elongated cells or tubes, filled with starch in the natural state. 'This layer constitutes the white velvety coating of the side of the squash seed, and is very much more developed in this than in the *C. pepo*.'

The cement is running in and spoiling this preparation.

2. Hairs and scales of *Shepherdia Canadensis*. W. H. Pratt.

3. Sand from the shore of Provincetown, Cape Cod. J. M. Crocker. 'Said to contain upward of a dozen varieties of minerals.' This is interesting information, but it would be desirable to know what the minerals are. This preparation was spoiled, and is 'out for repairs.' A fern leaf with fruit double stained has been substituted.

4. Diatomaceæ from Sandwich Islands. Elijah Brent. Very good diatoms, but the cover-glass might have been put on the middle of the slide instead of where it is, on one side.

5. Diatoms from marsh near Mount Auburn, Mass. L. M. Willis.

6. Diatoms from Island of Corsica. W. H. Curtis.

Box Cb came to hand February 18th with a fine preparation of pikrite from Mr. A. C. Cole's series. This was the only slide in the box.

Box Ca came to hand March 17th containing two preparations of Cole's series—one a transverse section of the stem of the copper beach, the other a section of the stem of the umbrella plant.

## NOTES.

—We find a notice in one of our valued exchanges to the effect that Mr. Duclaux has sent a communication to the Académie des Sciences, Paris, stating that from experiments he has made with the Dutch pea and haricot bean, he concludes that seeds will not germinate in soil freed from micro-organisms. This rather surprising conclusion requires, to say the least, confirmation before it can be regarded as of the slightest importance. A still more astonishing announcement is made in the same place in these words: 'Mr. Pasteur also states that he has found, by experiment on animals, that food which is free from micro-organisms cannot be digested.' It is truly astonishing how rapidly such squibs as these are taken up by newspapers and spread broadcast. The readers of this journal will not be carried away by the brilliancy of either of these remarkable observations. We



do not hold Mr. Pasteur responsible for the latter—there are cranks in all professions.

—We are indebted to Mr. W. H. Pratt, of Taunton, Mass., for two of his neatly mounted preparations, one of stained pollen-grains of the sunflower, the other spores of the fern *Osmunda cinnamomea*. Both are stained green.

—We have also received, from Mr. George Freeston, of Oswego, N. Y., two excellent preparations of *Volvox* and other algæ, which are unusually well preserved. One of the preparations contains some *Spirogyra* showing the fruiting condition very perfectly, and some of the finest mounted specimens of *Nostoc* we have seen.

—The microscopical societies of Easton and Bethlehem, Pa., gave an exhibition at Bethlehem on the evening of February 18th, at which a short address was delivered by the Rev. Mr. Wolle, followed by a display of objects by both societies. The meeting was well attended, the hall being crowded with visitors, eager to see the many wonderful things revealed by the microscopes.

—We have also received notice of two meetings of the San Francisco society, one of which was the annual meeting, when an address was delivered by the President, Mr. G. M. Kinne. This society is in a prosperous condition, and some good papers are expected during the year.

—It is feared by many persons that there will be an outbreak of cholera during the present year in this country. The disease advances steadily when once started on its way, and if we escape it, it will be almost a miracle. That its introduction could probably be prevented by an efficient health board acting for the general government, we have no doubt. Congress has not realized the importance of a health department, and the National Board of Health has, from want of appropriations, only a nominal existence. It is doubtful if economy in this direction is economy at all. Another serious epidemic will, perhaps, demonstrate more clearly than the last, that prevention secured by the annual expenditure of a few thousand dollars every year, is far better than the loss of life and depression of business always caused by an epidemic, which costs the country hundreds of thousands.

—While other governments are aiding the investigation of contagious diseases, by furnishing laboratories and placing funds at the command of competent men

to conduct important observations, what is our own government doing in this direction? Not only is its penurious policy shown in regard to appropriations for health officers, but it offers to its ablest and most unselfish investigators, who have already conducted many experiments of great importance, the privilege of doing as much work as they please at their own cost. This is the way the most advanced and enlightened and progressive country in the world encourages scientific researches!

—Referring to cholera above, it will be of interest in the same connection to quote from an article by Dr. Max von Pettenkofer, in *Popular Science Monthly*. He writes as follows:—

'The disease is best known in Europe under the names of cholera, cholera morbus, Asiatic cholera, since the epidemic of 1817 to 1819, in which the English army, under the command of the Marquis of Hastings during a war against the natives, was rendered unfit for fighting and almost annihilated. But cholera had never visited Europe till the present century, when in 1830 it appeared in Russia and spread to Poland, where war was prevailing. Since that time, sometimes at longer and sometimes at shorter intervals, cholera has appeared in Europe. The question why cholera remained a thousand years in India before it first began to migrate is one of great interest, but one which cannot be satisfactorily answered. The principal consideration appears to me to be that the event happened at the time when intercommunication in all directions, both by water and land, had become more rapid. The first steamship appeared in the Indian waters at the beginning of the second decade of the present century. By land also intercourse was greatly accelerated. The Russians possibly took cholera from India, Arabia, Afghanistan, or Persia, through couriers and stage-coaches. It soon became clear that cholera, the specific cholera-germ, was in some way or other propagated along the paths of human intercourse, and it also became evident that unless the germs found a suitable soil within a certain time they did not flourish. Observers soon discovered that cholera was more prone to appear in certain regions and to affect certain localities, while it shunned other districts; and, again, that other regions were only visited at intervals of many years. It is also a fact that Asiatic cholera never yet appeared at a place which had not previously been in communica-

tion with a region where cholera prevailed; and, further, that the disease from an infected locality never yet passed on to another place if the journey lasted a certain time without interruption. The large intercourse between India and Europe, more particularly England, by means of ships which sailed round the Cape of Good Hope, had never succeeded in carrying cholera from India to England.'

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## CORRESPONDENCE.

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### Concerning Angles.

TO THE EDITOR :—\* \* \* In the November number of the JOURNAL, 1884, under the head 'Choosing Objectives,' you make the statement that a 'Hartnack water-immersion at \$45 probably will not do what the Spencer homogeneous immersion at \$55 will do.' I have been working with wide angle homogeneous objectives for the last three years, and I have Tolles  $\frac{1}{10}$  and  $\frac{1}{8}$  each 126° B. A., and my experience is simply this, that no water-immersion objective that I have examined is in any respect their equal for histological work or anything else. I use the microscope daily, and have had several hundred dollars worth of various grades of objectives to examine. Now, as a matter of fact, I ordered of Dr. Chase a Spencer  $\frac{1}{8}$  of 100° B. A. which you so highly recommended in the JOURNAL, and I can say that it was one of the best high-powers I had examined; yet it did not do the work of the Tolles  $\frac{1}{10}$  or  $\frac{1}{8}$ , so I exchanged for a Spencer  $\frac{1}{16}$  of 115° B. A. I consider this  $\frac{1}{16}$  of 115° B. A. worth about twice as much as the one of 100° B. A. For all ordinary work its resolution is greatly superior to the one of a 100° B. A., its working distance is ample, its definition and resolution are all that could be expected for the angle.

Another statement made in the article above mentioned is this :—'Even for those refined studies of bacteria and diseased germs, which have attained such great importance at the present day, these objectives [water-immersion] are to be most highly recommended.' One question may be asked here, is it possible for a low or medium angle water-immersion objective to give as sharp and clear definition of those minute organisms as a first-class homogeneous-immersion objective of high angle can? I have tested both kinds of objectives with bacteria, salivary corpuscles, and histological slides of various kinds, and I will have to see the water-

immersion objective that is in any respect the equal of a well-constructed homogeneous-immersion objective of 126° B. A. They, water-immersion objectives, are useful on very thick histological sections, because their working distance is greater than high angle homogeneous objectives of high power. I have a Tolles  $\frac{1}{4}$  of 126° B. A., which works easily through three and four thin cover-glasses, and I deem it one of the best histological lenses ever made. I can examine almost anything with it. It resolves *Amphipleura* in balsam beautifully, and can do the work of any ordinary dry  $\frac{1}{4}$ . Now, in conclusion, I will state that of all the objectives I have examined, I found none equal to Tolles' or Spencer's best work. The JOURNAL has been a welcome visitor to me for the last three years. I deem it a most useful publication. PIERCE TYRRELL.

ELGIN, Ill.

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## NOTICES OF BOOKS.

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*Second Annual Report of the Bureau of Ethnology to the Secretary of the Smithsonian Institution, 1880-81.* By J. W. Powell, Director. Washington: Government Printing Office: 1883. (4to, pp. 477.)

Among the many publications of a scientific character issued by the authority of the United States Government, few can compare in general interest, or in excellence of form, with the two reports of the Bureau of Ethnology, under the able direction of Major Powell. It is impossible to condense within the few lines that can be here accorded to notices of books, anything that will convey even a faint idea of the varied contents of this, the second large volume. Ethnology includes a vast range of subjects. We find here the results of long study of the languages and customs of the aborigines of America, of their folk-lore and strange myths, superstitions, and religion, their arts and industries. The volume includes an illustrated catalogue of the collections obtained by Mr. James Stevenson from the Indians of New Mexico and Arizona.

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## Exchanges.

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[Exchanges are inserted in this column without charge. They will be strictly limited to mounted objects, and material for mounting.]

Palates of molusca in exchange for other objects, mounted or unmounted.

A. B. AUBERT,  
Orono, Penobscot County, Maine.



# THE AMERICAN MONTHLY MICROSCOPICAL JOURNAL.

VOL. VI.

WASHINGTON, D. C., MAY, 1885.

No. 5.

## Koch's Method of Isolating and Cultivating Bacteria as used in the Laboratory of the Bureau of Animal Industry, Dept. Agriculture.\*

BY DRS. D. E. SALMON AND THEOBALD SMITH.

In investigating the causes of infectious diseases that are supposed to be due to micro-organisms three lines of research are considered essential to a complete demonstration. We must, in the first place, prove by microscopical means the existence of the suspected microbe in the diseased organs or tissues of the body. This microbe must then be isolated and cultivated outside of the body in a state of purity, and finally it must produce the disease when the pure culture is introduced into the animal organism. In the study of infectious diseases affecting mankind only, the third requisite must necessarily be set aside, yet the other two may be so strengthened that their evidence alone will furnish a strong probability.

The communication this evening is to deal with some recent methods bearing on the cultivation of pathogenic bacteria in a state of purity. The nature of the problem before us may be most readily comprehended with the aid of a few simple illustrations. There are certain bacterial diseases in which the microbe is confined to the blood almost exclusively, as, for instance, in the various forms of septicæmia and anthrax. In certain others they may multiply on the serous surfaces of the thorax and abdo-

men, in the subcutaneous connective tissue, or in the lymphatics. In such cases, the specific microbe may be obtained free from other bacteria at the outset and a pure culture obtained directly if proper precautions be observed. Minute portions of blood or of the effusion into the serous cavities or subcutaneous tissue, transferred with a pipette, needle or platinum loop into tubes containing liquid or solid culture media, will in most cases give the desired result. There are a number of other infectious diseases in which the pathogenic microbe does not occupy the ground alone. The intestinal and the respiratory tract in health always contain numerous forms of microbes, most of which are harmless, saprophytic forms. Diseases in which the lesions, due to the presence of micro-organisms, involve these tracts are not uncommon. Asiatic cholera and swine plague are well-known illustrations. The disease-germs, as they are popularly called, are mingled with the numerous bacteria normally occurring there to such an extent that the minutest visible portion which may be transferred to culture-media will contain at least two or three species. Placed in liquid media each species will multiply, that one most rapidly which meets conditions most favorable to its growth. Within one or two days each drop of the culture-liquid will probably teem with each of the forms sown, and to transfer a small portion to another tube would simply reproduce former conditions; the second culture would be equally impure. The method of dilution has been used with more or less success in these

\* Abstract of a communication to the Biological Society of Washington, D. C., April 18th, 1885.

cases, but it requires much labor and apparatus.

A method has been recently introduced by Dr. Koch which enables us to secure pure cultures from mixtures without much labor, and which furnishes, in addition, the means of distinguishing different species with a low power. The method, in brief, consists in distributing individual microbes through a liquid medium which rapidly gelatinizes. The microbes are thus forced to remain isolated and to multiply *in situ*. The steps of the process are as follows: A minute portion of tissue or liquid which contains, among others, the pathogenic microbe is thoroughly shaken up in about 10 c.c. of sterilized water. We prefer sterilized broth, and thus obtain a liquid culture of the various forms, the examination of which may serve as a check upon errors in the plate-cultures to be described later. We have at hand some nutritive gelatin which is prepared according to Löffler's formula: 10% gelatin, 1% peptone,  $\frac{1}{2}$ % common salt dissolved in an infusion of meat. This gelatin remains solid at ordinary temperature, but liquefies above 80° F. The gelatin is stored for this purpose in test-tubes provided with a cotton plug, each containing about 10 c.c. The gelatin having been liquefied by gentle warming or by placing in the thermostat at 100° F. for a short time, the protruding portion of the cotton plug is singed away and the tube thoroughly heated in the flame around the plug itself until the latter turns slightly brown. This will insure the destruction of all bacteria that may have gathered on or around the plug. A drop of the fluid in which the bacteria have been distributed is transferred to the liquid gelatin, and this in turn is thoroughly shaken to secure uniform distribution. The gelatin is then poured upon sterilized glass plates which have been cooled in a refrigerator, and upon which it rapidly solidifies, so that the plates may be placed under a bell-jar in a moist at-

mosphere within fifteen minutes. In these manipulations the object sought is to secure such a distribution of the bacteria on the plates that they will not interfere with each other as they develop, and that they are far enough apart to allow each centre of growth to be touched with a needle without touching adjacent centres. Since the number of bacteria will vary with their source, the amount of dilution necessary in each case cannot be foretold. Judgment and experience must be our guides. We have found glass plates measuring about 8 by 10 cm. a convenient size. It is more expeditious in most cases to transfer fluid with a platinum loop than with a pipette. The loop carries smaller quantities, and is more easily sterilized.

After a period of from 24 to 48 hours minute opaque points are perceptible on the plates. Each of these represents the progeny of a single microbe, which has multiplied until the brood numbering thousands becomes visible to the naked eye. Under a low power these so-called colonies are observed to vary greatly according to the species of bacteria of which they are made up. Some are spherical, with sharply-defined outlines, others with circumference not very distinct; some bear protuberances of various forms; some have an area of liquid gelatin surrounding them, or are situated at the bottom of steep, funnel-shaped depressions; some have peculiar markings on their surface. They may be made up of granules or appear homogeneous. Finally, they may differ in refrangibility and in color. It is needless to say that such distinctions must be carefully noted. By removing, with a sterilized needle under a dissecting microscope, a colony, as each centre of growth is called, and mixing on a slide with a drop of sterilized water, the microscopic characters of the different forms of colonies are readily determined. The plate-culture has thus given us pure cultures of all the bacteria in the origi-



nal mixture which were capable of multiplying in the nutritive gelatin at the temperature of 70°–80° F. These pure cultures are represented by minute colonies, which will soon invade one another's territory. To study the differential characters of the various microbes thus isolated, their morphology and biology, larger cultures are prepared in the following manner: A sterilized needle melted into a piece of glass tubing, to serve as a handle, is made to pierce a given colony carefully singled out under a dissecting microscope, and then introduced into a culture-medium contained in these culture-tubes which have been devised by Dr. Salmon and described in the first annual report of the bureau, 1884. These tubes are used exclusively by us for these cultures. The test-tube plugged with cotton which Koch employs seems poorly adapted for the purpose. The media at present employed for the cultivation of pathogenic forms in tubes may be roughly classed as solid and liquid. Nutritive gelatin has been employed quite extensively of late, no doubt on account of its use in the culture and diagnosis of the 'comma-bacillus.' We have here a number of tubes which illustrate very well the microscopic appearances of different bacteria. The gelatin is liquefied by most of them, but the manner and the progress of liquefaction present interesting features. Micrococci which we could not distinguish satisfactorily under the microscope are here shown to grow very differently. Another valuable medium introduced by Koch when cultivating tubercle-bacilli is blood-serum. We have here a series of cultures, in this medium, of different forms of micrococci, and each growth presents peculiarities of its own. Several have the power of liquefying the serum, while the rest limit their growth to the surface, the growth in the track of the needle remaining nearly stationary. These growths on potato are interesting, inasmuch

as they show that certain pathogenic bacteria may multiply on vegetable substrata, besides furnishing us with additional means of distinguishing different bacteria with the naked eye. Both cultures are micrococci, yet one forms a reddish growth, the other a whitish one. This color, moreover, is not appreciable in any of the previously-mentioned media.

Various liquid media have been employed in our work, consisting chiefly of decoctions and infusions of lean meat. Sterilized milk offers some points of interest. Certain bacteria will cause speedy coagulation; others will multiply without producing any perceptible change in the appearance of the milk. Still others may change the appearance and color entirely without inducing coagulation.

However much may have been said against the use of liquid cultures, we must admit that in general they cannot be dispensed with. They are essential in microscopic work; they offer a convenient medium for inoculation experiments on animals, for testing all important biological questions such as the influence of heat, disinfectants, etc., and for studying the attenuation of virus.

The method of plate-culture was first introduced by Koch in the biological analysis of drinking-water. His object was to determine the number and kind of bacteria contained in a given quantity of water. It is evident that in making this application of the method, the scrupulous care necessary in quantitative experiments must be observed, while in the isolation of bacteria from a mixture we need not dread the occasional lodgment of an aerial germ on our plates as our results are to be qualitative rather than quantitative. Accidental contaminations are usually spores of fungi and isolated colonies of bacteria readily distinguished from the rest. In the same way earth has been subjected to analysis with reference to the number and kind of bacteria which it contains.

The gelatin plate may be employed in still another way, which, however, preceded the one already mentioned in the order of time and no doubt paved the way for its invention. If we dip a needle into a liquid culture and draw it rapidly across the surface of a layer of gelatin, we have distributed in this line or track a number of bacteria, the fewer scattered along the way the better. In from one to two days this track, at first scarcely visible, becomes defined as an opaque line, and under a low power the colonies, descended from single bacteria, may be seen distributed irregularly along this line. These line cultures, as they might be called, present all the characters and variations which belong to the isolated colonies, and in fact quite frequently we are fortunate enough to observe single colonies in the track itself. By drawing 3 or 4 lines from different cultures on the same plate as has been done with these, we are enabled to compare their growth directly and also to determine whether the culture from which each line was inoculated was pure at the time. If all the colonies occurring in a given track are identical in appearance as they enlarge, no matter what may appear on the plate beyond the track, we may safely assume that the culture from which the colonies originated was pure, in that it contained but one distinct form or species. This method was used on substrata not so easily liquefied, such as agar-agar and blood-serum. Dr. Rosenbach in a recent work\* used these line-cultures on agar-agar almost exclusively, the method of isolating germs not having been introduced. In spite of the care with which the work was done and accuracy with which the plates were drawn, we cannot but feel that it must be done over again with more recent methods to be of permanent value.

All of these methods must of ne-

cessity be employed in the future in the study of any micro-organism in order that the work may be received with confidence and form the basis of additional and more extensive investigations.

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### Abbe Condenser.

We present this month an engraving of the very simple and inexpensive mounting for the Abbe condenser made by Mr. Zentmayer. The lower

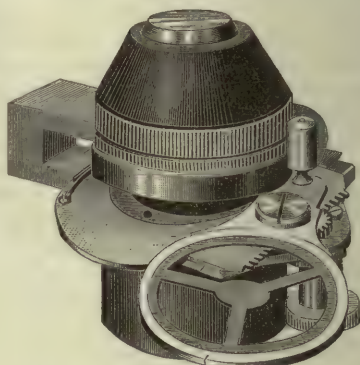


FIG. 13.—Zentmayer's Abbe Condenser.

ring fits into the substage-ring, and can be made to fit any microscope. The milled head, seen below on the right, moves the plate which carries the diaphragms, one of which is shown resting against the apparatus. The arrangement for this purpose is very neat and convenient. The cumbersome mounting of Mr. Zeiss is not suited to the stands made in this country, and the lighter forms now made by several of our opticians are quite as efficient in every way.

This condenser will fit the 'Histological' stand, thus making the latter equal to any demands that may be made upon it by the student of the most evanescent microbes of disease.

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### Lantern Transparencies.

BY C. M. VORCE, F. R. M. S.

Where a considerable number of lantern slides are desired, as for distribution among co-workers, they can

\* *Mikro-organismen bei den Wundinfektionskrankheiten des Menschen.*



be made considerably cheaper by the use of the carbon process than by using dry plates. The process is very cheap and not difficult of application. Prepare a solution of gelatin in distilled water, which when warm shall be quite fluid, not much thicker than milk. In this, while warm, place a small piece of bichromate of potassium, and shake the mixture till it acquires a strong yellow color; then remove the undissolved bichromate and add enough thick indian ink well rubbed up in water to render the emulsion so black that when held between the eye and a gas-jet large print cannot quite be read but can be just dimly distinguished.

Now take plates of clear glass cut to proper size and thoroughly cleaned, warm them and flow them with the black gelatin emulsion so that a thin, even coating is left upon the glass. Any excess may be poured back, just as wet plates are coated with collodion. Dry these gelatin plates in the dark, keeping them level until the film has set, when they may be placed on edge and the drying finished. They are now sensitive to light and must be kept and handled like dry plates, which in fact they are, only less sensitive than the bromo-gelatin dry plates generally used.

To use these carbon plates they are placed in a printing frame under a negative and exposed to sunlight for about the same time required for silver prints, and when removed from the printing frame in the dark room are first immersed in cold water, then in warm, and after two or three minutes soaking are held under a gentle stream of quite warm or moderately hot water, which speedily dissolves and washes away the gelatin forming the lights of the image, while the shadows having been acted on by the sunlight, are insoluble and but slightly lose their color in washing. When the image is sufficiently clear the plate is rinsed in cold water and dried in the light.

The lantern slides when dry are

mounted and used precisely as those made upon the ordinary dry plates.

Paper coated with the same emulsion will give prints in the same way, and such are the 'carbon prints' so much used in England and on the Continent, but paper is more difficult to manipulate than glass—at least I have found it to be so.

Lantern transparencies when prepared to show microscopic objects very highly magnified are best made from camera enlargements of a less highly magnified negative, as follows: Prepare a negative showing the desired points by means of an objective of as low power as will clearly show all the desired details. This negative will be smaller than is required but will be a better one than one made of the desired size by a higher power, because the penetration of the objective—however much abhorred penetration is of real value here—will give sharper projection than if a higher power were used. Place the negative in a copying camera and enlarge it to the desired size if possible, if not a second enlargement would be required, but is seldom if ever necessary. The second plate, that is the enlargement of the first negative, is a positive, and if well done may be mounted as a lantern slide, but first a negative is made from this by contact printing, and from this negative not only paper prints but other lantern positives may be made at will. It should be noted that if any retouching in the original negative is required it must be done with care and skill as any errors would be exaggerated by the enlargement, but the enlarged positive may be freely retouched before being used for contact printing, and thus letters, figures, names, etc., may be introduced into the lantern slides prepared from the last negative, which also may be retouched if necessary like any other negative. The superiority of such enlargements over negatives made originally of the same size is often very marked.

## The Gum of Liquidambar Styra-ciflua or American Storax as a Mounting Medium.

BY PROF. A. B. AUBERT.

This gum is an exudation of the sweet gum tree of the Southern States, scientifically known as *Liquidambar styraciflua*. The more tropical the climate the greater the quantity of gum produced.

The gum is usually light-colored, being at times nearly white, while other specimens may be considerably darker, of a greyish yellow or light brown color. In consistency it varies somewhat, but is generally as thick as pine pitch of good quality. It is soluble in alcohol, ether, chloroform and benzole. Its odor is pleasant. Cinnamic acid and styracin are among its constituents.

Through the kindness of a friend I have been able to use the gum as a mounting medium, and have been very much pleased with it. I have had to work with rather small quantities, but I find a chloroform solution all that can be desired for diatom mounts. A benzole solution replaces most satisfactorily the benzole-balsam solution.

The method of preparing these solutions is simple enough, and anybody who can obtain a specimen of the gum will find it easy to prepare them for use. When the specimen is small it may be exposed in an open vessel in the water-oven to a temperature of 100° C. for from four to eight hours. This thoroughly dehydrates the gum, and when cool and hardened it may be dissolved in benzole or chloroform; this solution must be set aside for a few days to allow flocculent matter to form and settle, then filtered, and, if necessary, a part of the solvent evaporated.

There is a better way of preparing the solutions, but a larger quantity of the gum must be obtained in order to carry it out. The first step in this process is the filtration or straining of the gum. This is done by cutting the bottom out of a small wide-mouthed

bottle, tying muslin of rather loose texture over the mouth, inverting the bottle over a vessel, and partly filling it with gum; now expose the whole apparatus to the heat of a water-oven for from six to ten hours. The gum melts and filters through the muslin. The filtered product is of a clear amber color, readily dissolves in the solvents, and gives much lighter solutions than can be obtained by the first-mentioned process.

The gum is so adhesive that it cannot be gathered without including some debris of bark, wood, etc.; these, when not separated by filtration, give up some coloring matter to the solvent, rendering the solution somewhat darker. The solution obtained from filtered gum is not much darker than Canada balsam.

In using these solutions as mounting media the method of procedure is very similar to that for balsam mounts. The chloroform solution I have used exclusively for diatoms, boiling a few seconds to expel all air. When mounting in the benzole solution objects are dehydrated in absolute alcohol, cleared in oil of cloves,\* which must be carefully drained off and absorbed by blotting-paper before adding the drop of gum solution and applying glass cover. It is best to harden the mounts in a warm place. When slides are allowed to harden at ordinary temperatures the gum may show signs of cloudiness; this is readily made to disappear by the application of a little heat, and I have never observed the turbidity to reappear after this treatment.

My experience with the gum has proved that it can in about all cases be used instead of Canada balsam, indeed that it is superior to balsam, showing the finer parts of objects more clearly. I have entirely discarded balsam for diatoms. Cartilage when properly stained shows very well, better in my opinion than

\* I am not entirely satisfied with oil of cloves to clear objects that are to be mounted in this medium. As time permits I hope to experiment on other essential oils.



in glycerin jelly. For histological objects generally it will be a welcome addition to the present stock of mounting media. Tooth, bone and other sections would undoubtedly show to better advantage in this medium than in balsam.

Mr. C. V. Smith, of Carmarthen, Wales, a well-known mounter of fine botanical objects, to whom I have sent specimens of this gum, speaks very highly of it for botanical mounts. He writes me that he has never tried any medium which showed aluerone grains in section of castor-oil plant as satisfactorily. It shows the mycelia of fungi more clearly than most other media.

Objects mounted a year ago show no signs of deterioration, and I have every reason to believe that it will prove an excellent medium for permanent mounts, preferable to balsam, not only on account of its higher refractive index but also because it seems somewhat less brittle.

When the solutions kept in capped bottles become thick by evaporation it is best to transfer them to a common bottle and add the proper amount of solvent. This will cause a flocculent precipitate. Let stand for several days, filter back into capped bottle, when a clear solution, ready for use, will be obtained. These solutions are liable to become turbid, but thus far I have had no trouble in using them, the hardened gum always proving perfectly clear and transparent, especially if hardened by the aid of slight heat.

ORONO, Maine.

[We have received a specimen of the gum from Prof. Aubert and also a sample of the solution in chloroform described above. Our experience in the use of the medium leads to a full confirmation of all that Prof. Aubert says concerning it. Two mounted preparations of diatoms accompanied the specimens, one of which is six months old and perfectly clear. The gum can be purchased in any drug store, and those who are

not provided with a chemist's drying oven can use the oven of a stove to dry the gum, or the gum may be placed in a wide-mouth bottle and stood in a vessel of hot water.—ED.]

### Microscopical Societies and Microscopy.\*

The Washington Microscopical Society takes great pleasure in welcoming their friends to this first annual *soirée*, which is a happy and encouraging close of the first year of our existence as a society. It is especially fitting that scientific societies should exist in Washington, which contains more men engaged in scientific pursuits, in proportion to its population, than any other city in the Union. And the number of these societies that have recently been established is only one sign of civic progress towards a broader, richer and more cosmopolitan life than we have yet shown. The first microscopical society in this country appears to have been formed in New York city, about the year 1840, chiefly of medical men, who are naturally particularly interested in the microscope.

At that time the Wilkes Exploring Expedition wanted a microscope, but none were on sale, and finally the loan of an instrument from Dr. Goddard was obtained. This early society had few immediate imitators. In 1870, at the time of forming a society in Troy, N. Y., there appears to have been only two or three in the United States. The establishment of the Postal Microscopical Club, in 1875, no doubt gave an impulse to microscopic work throughout the country, and in 1879 over thirty societies were reported to exist, which number has since much increased.

The microscope is an instrument for scientific research. In these days we hear much said of science, without always having a clear idea of its

\* Abstract of an address by Prof. W. H. Seaman at the first annual *soirée* of the Washington Microscopical Society, March 24th.

meaning. As a concrete thing, it is the written record of the experience and opinions of men trained in observation and in logical methods of thought. . . .

It is said that pieces of glass shaped like lenses have been found in the ruins of Assyrian towns, but if so their use was forgotten. The year 1590 is the first date that can be assigned with certainty to the first microscope, a huge thing like a dwarf telescope with dolphins for legs. In 1665 small globules of water were used, a device that may be imitated by a pill-box with a pinhole in the top and a drop of water in the pinhole. In 1672 Sir Isaac Newton made a reflecting microscope on the principle of the reflecting telescope. But so little hope did any one have of the successful application of the principle of achromatism, or the correction of lenses, then newly discovered by Euler, that so late as 1821 the construction of a good achromatic instrument was regarded as impossible.

The modern microscope dates from 1829, when Lister discovered the methods of aplanatic correction. Since his discovery there has been a steady improvement in the construction of lenses, which has not yet reached its limit. So short a time has elapsed since the construction of the first compound microscope, that its entire development has been accomplished in a single lifetime. One of the most agreeable personal reminiscences of my life was a meeting with Dr. Carpenter, of London, the well known author of 'Carpenter's Physiology,' and other valuable works, at Montreal, in 1882. Himself one of the leading microscopists of our time, he described the various steps in the improvement of the microscope and the more important discoveries made by it from personal observation and participation; being one of those of whom it might particularly be said that he was there and a part of it, having seen, and had

a share in, the improvement of the microscope from the very earliest beginnings.

The limit of vision was placed by Ehrenberg at  $\frac{1}{400}$  of an inch, that being the smallest object we can see with our naked eye, but with the most powerful instrument it may now be placed at a little over 100,000 lines to the inch. What this means it may help you to discover if you consider that an inch enlarged in like proportion would measure one mile and a half, or reach from here to the Capitol.

Probably there are not a dozen persons in the world at any one time who are competent to make a first-class, high-power objective, and anything that is so rare must necessarily command a high price.

The most expensive tools are not at all necessary to do good and valuable work with the microscope, or to obtain from it an immense amount of enjoyment. This latter use of the instrument is one that people are only just beginning to find out, and we hope to give you this evening some of the pleasure that any intelligent mind receives from looking into a new world, where everything is not only new and strange but in many cases wonderfully beautiful. Among the things you will see are some of the diatoms whose surfaces are marked with a fine net-work of carving in patterns that rival the finest lace in geometrical accuracy and intricacy, the surfaces of crystals that glisten and glow like polished gems, and, most beautiful of all, the wonderful effects produced by polarized light, which furnishes us with a means of analysis whereby the most minute molecular structure of matter is made known. But the microscope is far from being only a pretty toy or a means of seeing pretty things. It is not an extravagant statement that our knowledge of the physiological action and minute anatomical structure of living beings is wholly built on the use of the microscope. In 1636 Dr. Harvey held many and long arguments to prove



the circulation of the blood in animals. One of our members will endeavor to illustrate this physical fact this evening in a way that could Harvey have done it, would have rendered any further argument unnecessary. It is not now a question of whether or no the blood circulates in animals, but the question is, what are the primary causes of a similar circulation in plants? And instead of considering motion or the power of motion as the peculiar property of animal life, we almost persuade ourselves, as we look on the Brownian movements of inorganic particles, that all matter has something of life in its nature. But it is not merely for beauty or for scientific research that the microscope can be applied. It may play its part in the most ordinary concerns of life. It will tell you of the chicory the grocer puts in your coffee, and the cotton that forms the warp of your silk dresses. You may see through it the menagerie you keep in the vinegar cruet, and you will have explained to you this evening by a member of the society the difference between butter and oleomargarine, a difference allow me to assure you that you can find out in no other way. And finally when stern justice puts on her cap, and, clothed in the majesty of law, seeks to hunt out, to punish the murderer, it is not unfrequently to the microscope that appeal is made for evidence in no other way to be obtained.

Hundreds of years ago when the Danes ravaged the east of England they pillaged a church. Tradition said that the Saxons captured some of them and for this sacrilege flayed them alive and nailed their skins to the church door. A few years ago, on taking down the old church door and removing the hinges, portions of something like dried leather fell out and revived the memory of the almost lost tradition. The material was collected and sent to a skilful microscopist, and when he examined these, after centuries of exposure he found

hairs that could only grow on a human form, and the tradition of ages was confirmed by the testimony of an art and an instrument that has grown up as it were since yesterday.

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## Staining Tissues in Microscopy.\*— II.

BY PROF. DR. HANS GIERKE.

### CARMINE.

1. Goppert und Cohn. Ueber die rotation des Zellinhaltes von *Nitella flexilis*. Botan. Zeitung, No. 37, 1849.

The first attempt to differentiate tissues by staining in microscopy.

2. Hartig. Chlorogen. L. c. No. 32, 1854.

Hartig stains chlorogen† with ammoniacal carmine and tries other dyes. Attempts to explain staining.

3. Hartig. Ueber die Functionen des Zellkerns. L. c. No. 33.

Investigates the facility with which carmine combines with various elements of plant structure. Nucleus only absorbs the dye, which unites with albumen and gelatin. Washed gluten and gelatin absorb dyes, but vegetable gums do not. In order to stain cell-nuclei the plant or tissue must be dead. The nuclei of living structures do not take color.

4. Hartig. Ueber das Verhalten des Zellkerns bei der Zellentheilung. L. c. No. 51.

Describes his method of investigation.

5. Lord S. G. Osborne. Vegetable cell structure and its formation, as seen in the early stages of the growth of the wheat plant. Trans. Micr. Soc., v, 1856.

Cultivated wheat in solution of carmine, and found the tissues colored, contrary to Hartig. Beale quotes Osborne to show the use of carmine before Gerlach's time.

\* From the *Zeitschrift für wissenschaftliche Mikroskopie*. Translated for this JOURNAL by Prof. Wm. H. Seaman, M. D.

† A name given by Hartig to portions of protoplasm that ultimately become chlorophyll-granules.

6. Hartig. *Entwicklungsgeschichte des Pflanzen keims.* Leipzig, 1858.

In this great work Hartig repeats many of the statements in his earlier articles. He grew algæ, chara, hyacinths and other plants for weeks in carmine without staining them. Only after death was the solution absorbed. He considers carmine indispensable for his work, and describes the method of preparation. He used other dyes, as iodine. This essay induced Dippe in 'Das Mikroskop' to consider Hartig the inventor of staining, and he does not seem to have known of the earlier work. Hartig has also been much praised by other botanists for his services in introducing staining, but he is not known in zoology or medicine.

7. Gerlach. *Mikroskopische Studien aus dem Gebiet der menschlichen Morphologie.* Erlangen, 1858.

Four years previously Gerlach perceived that in preparations injected with ammoniacal carmine, where the color diffused through the walls of vessels, that the nucleus was more deeply stained than the cells and intercellular substance. He then treated nerve sections with concentrated carmine solutions without good success; the elements were not well differentiated. Accidentally having left over night a portion of brain in a very dilute solution, a better result was obtained.

8. Gerlach. *Ueber die Einwirkung von Farbstoffe auf lebende Gewebe.* Wiss. Mitth. d. Phys.-med. Soc. Erlangen. 1858, p. 5.

Gerlach describes his efforts to dye living animal tissues, which did not succeed. Dead tissue gradually withdrew all the color from very dilute carmine, the nuclei and nucleoli absorbing the most, the cells less, and the intermediate substance least. It could not be washed out. A peculiar affinity seemed to exist between the dye and elementary parts, of the physical reasons for which we are yet ig-

norant. (Neither of the above articles contain anything more than Hartig had already shown with respect to plants.)

9. Maschke. *Pigmentlösung als Reagenz bei mikroskopisch-physiologischen Untersuchungen.* Botan. Zeit., No. 3. 1859: Journ. f. prakt. Chemie, lxxvi, 1859, p. 37.

Maschke knew of Gerlach's work, not of Hartig's. He criticised the theory of staining, and described numerous experiments. He used carmine especially, but also other substances, as indigo. He stated there are two groups of organic bodies, one whose members belong to the class of proteids, as horn, albumen, gelatin, which unite readily with dyes, while the members of the other group or the varieties of cellulose, amylums, sugar and gum do not take colors. At the close of his essay he strongly recommends staining. He says: 'In the future staining solutions will be as indispensable as the iodine test, and both in microscopic work will be held of equal value with the scalpel.' This interesting essay has never been properly esteemed.

10. Maschke. *Ueber einige Metamorphosen in den Zellen der reifenden Frucht von Solanum nigrum.* Botan. Zeit. 1859, No. 22 f.

Description of the investigation made in 1857 in which he employed carmine.

11. Thiersch. *Injecting fluids of Thiersch and W. Muller.* Schultze's Archiv f. Mikr. Anat. 1865, p. 149.

a. Carmine 1, liq. ammon. caust. 1, aq. dist. 3. Mix one volume of this solution with 8 of oxalic acid (1.22 of water.) To this mixture add 12 of absolute alcohol, and filter. The addition of more oxalic acid to the filtrate gives an orange red, while excess of ammonia turns it violet. This fluid tinges cells deeply in a few seconds. Diluted with 70 or 80% spirit of wine it colors more slowly. The



addition of absolute alcohol precipitates acid ammonium oxalate. If the stain is too deep or irregular, it may be cleared by an alcoholic solution of oxalic acid. This staining fluid is to be recommended for all purposes, without regard to previous treatment of the preparation.

8. Carmine 1, borax 4, aq. dist. 56. Mix 1 volume with 2 of absolute alcohol; filter. For bones decalcified by chromic acid. May be cleared by solution of oxalic acid or borax in spirit of wine. Gives lilac tint.

12. Beale. How to work with the Microscope. 5th ed. London, 1880, and in the earlier editions.

Carmine 10 grains, liq. ammon. caust.  $\frac{1}{2}$  drachm, glycerin 2 oz., aq. dist. 2 oz., alcohol  $\frac{1}{2}$  oz. Shake the carmine and ammonia in a test tube, boil a few minutes, cool for an hour, add the water, glycerin and alcohol, and filter. Keeps for months; if carmine precipitates, add a few drops of ammonia.

Beale recommends this form of ammoniacal carmine as better than any other. I have stained much with it, and do not perceive it has any particular advantages over the simple ammoniacal carmine, certainly not for sections which require dilute solutions, and for which the glycerin and alcohol are of no use. For staining in mass, that is, of pieces to be afterwards cut into sections, it is to be recommended as more penetrating than simple watery ammoniacal carmine. Perhaps the glycerin and the alcohol give it this character.

13. Schweigger-Seidel. Cyon, Ueber die Nerven des Peritoneum. Ber. d. Sachs. Gesellsch. d. Wiss. 1868, p. 125.

Cyon worked in the histological laboratory at Leipzig, and used Schweigger-Seidel's acid carmine, which he warmly recommends.

Ordinary ammoniacal carmine is to be saturated to excess with acetic acid, and filtered, making a wine-red color. The preparations may be cleared

by acid glycerin—hydrochloric acid and glycerin 1-200. The dye settles in the nuclei, and the protoplasm will be bleached. The preparations should be thoroughly washed, and are not so permanent as ammoniacal carmine.

14. Rollet. Bemerkungen zur Kenntniss der Labdrüsen und der Magenschleimhaut. Unters. a. d. Inst. f. Physiol. u. Histol. Graz. Heft 2. 1871, p. 143.

Rollet describes several processes to make carmine solutions more permanent, by adding definite quantities of free acids, avoiding precipitation of the color.

15. Graucher. Technique mikroskopique. Des usages de la solution ammoniacale de carmin en histologie. Arch. de Physiol. iv, p. 770.

Graucher examines the behavior of animal tissues toward ammoniacal carmine. He finds the greater the vitality of any part, the more readily it stains. Elements already colored by other dyes, as chromic acid, picric acid, potassium bichromate, chloride of gold, iodine, etc., take carmine slightly or not at all. The same is true of elements normally having special coloring matter, as the blood-corpuscles, which absorb carmine readily on the removal of the hæmoglobin. (Much may be said against the above statement).

16. Woodward. The best mode of carmine staining tissues. Monthly Micr. Journ. viii, p. 37.

Carmine 1, saturated solution borax 60. Add twice as much absolute alcohol, filter and use the precipitate of crystals of borax-carmine. The crystals should be dissolved.

17. Betz. Methode feine Schnitte a. d. Centralnerven-system anzufertigen. Mittheil. d. ärztl. Ver. Wien. 1872, i, p. 9.

Betz sets carmine solution in the sun till a dark, flocky precipitate falls, then filters and uses the filtrate. This is the so-called 'precipitated

carmine,' supposed to be less liable to alteration.

18. Lieberkuhn. Ueber die Einwirkung des Alizarin auf die Gewebe des lebenden Körpers. Sitzungsab. d. Gesells. z. Beförderung d. ges. Naturwiss. Marburg. 1874, No. 3, p. 33.

Experiments to ascertain if living tissues would stain. Injections of ammoniacal carmine in the lymph sacs of the backs of frogs. (See previous articles.)

19. Richardson. Mode of staining animal tissues of a permanent purple-grey color. Quart. Journ. Micr. Sci. 1874, p. 281.

Carmine solution mixed with Draper's dichroic ink strongly recommended. The ingredients of the ink are unknown.

20. Pouchet et Legoff. Sur la fixation du carmin de cochenille dans les éléments anatomiques vivants. Gaz. med. de Paris. 1876. No. 52. See No. 17, above.

21. Hoyer. Beiträge zur anatomischen und histologischen Technik. Archiv. mikr. Anat. xiii, p. 649.

Hoyer thinks the power of ammoniacal carmine is increased by adding alcohol. Beale's solution is preferred on that account, the glycerin is rather an injury. The following troublesome process gives a powerful dye. Warm some carmine in a flask with alcohol to which a little sulphuric acid has been added, till it dissolves. Filter and dilute with much water. Add to the filtrate lead acetate so long as the rosy precipitate of lead sulphate forms. As soon as the precipitate becomes violet, filter and to the filtrate add lead acetate till the violet precipitate no longer forms. Collect this, wash, dry, dissolve in a little strong alcohol, and add alcohol acidulated with sulphuric acid drop by drop till the precipitate is colorless and the alcohol a

deep red. This alcoholic solution is a powerful dye.

22. Obersteiner. Technische Notiz. Arch. mikr. Anat. xv, p. 136.

Obersteiner dyes sections of large nerves with ammoniacal carmine by exposing them 2 to 5 minutes in watch-glasses filled with the dye to hot steam. He finds the sections stain quickly and well, and he appears to use a rather concentrated solution. (I have tried his method, and can confirm his statements, but do not recommend it, except to save time.)

23. P. Mayer. Die Verwendbarkeit der Cochenille in der mikroskopischen Technik. Zool. Anz. 1878. No. 15, p. 345.

Mix powdered cochineal with 70% alcohol, digest several days, filter. The proportions are 1 gram. of cochineal to 8-10 c. c. alcohol. Alcoholic preparations free from acid are the best for staining.

(The following method of boiling cochineal with alum is much better.)

24. Grenacher. Einige Notizen zur Tinctionstechnik besonders zur Kernfärbung. Arch. mikr. Anat. xvi, p. 463.

A watery solution of alum or alumed ammonia (1 to 5%) is boiled 10 to 20 minutes with  $\frac{1}{2}$  to 1% powdered carmine and filtered after cooling. The purple solution dyes nuclei only very quickly, and no excess of color results from long soaking.

25. Grenacher. l. c.

One or two per cent. of borax in water is boiled with  $\frac{1}{2}$  to  $\frac{3}{4}$ % of carmine. The cooled solution is treated, drop by drop, with dilute acetic acid till it assumes the color of the ordinary ammoniacal carmine. After standing 24 hours, filter. It stains diffusely, but the color may be confined to the nuclei by washing with 50-70% alcohol containing a few drops of muriatic acid.

26. Grenacher. L. c.

In 50 c. c. of 60-80% alcohol, with 3-4 drops of hydrochloric acid, boil a pinch of carmine for 10 minutes. Cool and filter. Sections stained with this



fluid require treatment with hydrochloric acid to bring out the nuclei; otherwise they are diffusely stained.

(We do not regard the last two compounds as valuable additions to our list.)

27. Schneider. Ueber die Anflosung der Eier und Spermatozoen in den Geschlechtsorganen. Zool. Anz. 1880, Jan. 12th and May 24th.

Schneider boils 45% acetic acid and adds as much carmine as it will dissolve. Stains with this solution direct or dilutes it to one per cent.

28. P. Mayer. Ueber die in der Zoologischen Station zu Neapel gebräuchlichen Methoden zur mikroskopischen Untersuchung. Mitth. a. d. Zool. Stat. Neapel. ii, 1-27.

Coarsely powdered cochineal is left covered by 70% alcohol for several days. The tincture is not a strong dye, but selective.

29. Czokor. Die Cochenille-Carminlösung. Arch. Mikr. Anat., xviii, p. 712.

Cochineal 7 grms., roasted alum 7 grms., rubbed together in a mortar. Add 700 c. c. distilled water and boil till reduced to 400 c. c. Cool, add a trace of carbolic acid as preservative and filter till clear. The liquid is violet, will keep six months, when it may require additional carbolic acid and filtration. For tissues generally, however hardened. Excellent for the nuclei, which takes the color of hæmatoxylin, while the other constituents are stained various shades of cherry to dark red. (The best substitute for ammoniacal carmine, and to be preferred, for staining nuclei. It is better than the anilins, and may be used for ordinary purposes in the place of any other dye, especially hæmatoxylin. It is particularly adapted for beginners, and for laboratory courses for instruction. For large nerves it is to be recommended

only for staining nuclei. Nerve cells and their prolongations are not well shown. In summer, unfortunately, a precipitate often appears. I filter just before using, usually.

30. Hoyer. Beiträge zur histologischen Technik. Biol. Centralbl. ii, p. 17.

Hoyer thinks it very necessary to have a dry preparation of ammoniacal carmine, that may be applied in definite proportions and kept on hand without deterioration. For such a material he takes 1 grm. carmine and 1-2 c. c. strong ammonia and 6-8 c. c. distilled water and warms till the excess of ammonia evaporates. It will be finished when large bubbles no longer appear on boiling, and the liquid becomes a clear red. Cool and filter, the result will be a neutral solution, which is treated with one or two per cent. of chloral hydrate and may be kept and applied like ordinary ammoniacal carmine. On adding 4 to 6 volumes of strong alcohol a copious, bright-red precipitate falls, which is to be filtered, washed and dried. By mixing it with alcohol and a little glycerin and chloral hydrate the alcohol will be changed to a paste that is also very permanent. Both preparations consist of perfectly neutral ammoniacal carmine. They are strong dyes and very convenient.

(The above compounds made by Hoyer himself work well, and some of his preparations of the spinal marrow sent to Privy Councillor Heidenhain leave hardly anything to desire. But such as are sold in the market, though made by Hoyer's directions, are far inferior to ordinary ammoniacal carmine).

31. Maschke. 1882.

Has experimented much with carmine, and has made dry sodium carminate. I have used this, and find that by a small addition of ammoniacal salt (as ammonium bicarbonate 2-5 drops in a watch-glass) it is of great service.

It is to be used exactly like ammo-

niacal carmine for similar purposes, but is more convenient and has the advantage that it may be applied in definite quantities. Like Hoyer's, it is well adapted for double staining and for picro carmine, and is much to be preferred to the commercial article called by Hoyer's name.

I add here a few carmine preparations whose authors I can give, but not date and place of publication. Some of them are among those best known:—

32. Frey. *Das Mikroskop und die Mikroskopische Technik.* 7 Aufl., Leipzig, 1881. (In the 3 Aufl., 1868, not given.)

Dissolves carmine in acetic acid, adds water, and filters.

33. Perls. *Nach mündlicher Mittheilung an Frey.* In dessen, *das Mikroskop und die Mikroskopische Technik.* 7 Aufl., 1881.

Perls finds that the carmine now in market is sufficiently soluble in water to make a stain. (This does not appear true of all kinds; my best is almost wholly insoluble.) He recommends the following method: Carmine is slowly boiled for an hour in water, then filtered. The filtrate is at first cloudy. It is to be repeatedly passed through the same filter till of a clear red. Perls thinks it stains chromic acid preparations better than ammoniacal carmine.

(I do not consider the above to compare favorably with ammoniacal carmine or sodium carminate, because it does not give clear stainings.)

34. Rollet.

Recommends carmine in water. Boils ordinary carmine with dilute sulphuric acid a precipitate of fermentible sugar, and a dark red mass  $C_{11}H_{12}O_7$  is obtained, slightly soluble in water and alcohol. It possesses no advantages over carmine (carminic acid).

35. Ranvier.

Recommends clearing diffuse stainings in formic acid instead of acetic or muriatic. (Glycerin 100 to 1 of formic acid).

In this connection I must protest against the numerous objections to the use of ammoniacal carmine. I have kept concentrated solutions a year without mould, and have some that is eight years old. It is true it was made from the best carmine of the old make. The early directions succeed well, even with chromic acid preparations; want of success is usually due to bad manipulation or a bad quality of carmine. A slight addition of ammoniacal salts (possibly others also) improves its action very much, and may be necessary for some purposes. Old ammoniacal carmine always contains ammonium carbonate or bicarbonate through absorption of carbon dioxide from the air.

Although it may seem from this collection that a sufficient number of processes for staining with carmine already exist, and perhaps some we could well dispense with, yet I will add one I employed long ago for staining the great nerves. It is especially to be recommended when the material has lain too long in alcohol after hardening by chromic acid, or after too much chromic acid, the carmine does not stain deeply enough. I lay the sections for 24 hours in a 1% watery solution of uranium nitrate, sulphate, or chloride, wash them well, and treat them 10 to 24 hours with dilute ammoniacal carmine. The preparation, colored by the uranium salt slightly yellow or green, takes a dark purple; the nuclei are better shown than with carmine alone; the nerve cells and their prolongations are extremely clear. This method may be applied to other organs, but does not for them have especial advantages. A purple staining fluid may be made by adding some of the uranium salts to a dilute ammoniacal carmine solution, and filtering after some hours. This dyes nerves very clearly, but I prefer the first method. Carmine is often used for double staining, which see.

[To be continued.]



## EDITORIAL.

**Publisher's Notices.**—All communications, remittances, exchanges, etc., should be addressed to the Editor, P. O. Box 630, Washington, D. C.

Remittances should be made by postal notes, money orders, or by money sent in registered letters. Drafts should be made payable in Washington, New York, Boston, or Philadelphia.

Subscription-price before April 1st, \$1 per year, in advance. All subscriptions begin with the January number. After April 1st the subscription-price will be \$1.50.

The regular receipt of the JOURNAL, which is issued on the 15th of each month, will be an acknowledgment of payment.

The first volume, 1880, is entirely out of print. The succeeding volumes will be sent by the publisher for the prices given below, which are net.

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Vol. V (1884), Nos. 2-12, \$1.00.

**TO SUBSCRIBERS.**—There are a few of our old subscribers who are disposed to take offence because their JOURNAL is stopped when subscriptions expire. A very little consideration will convince them that such a rule is a perfectly just and proper one, and also that, having made the rule, it is not reasonable to expect us to go all through our subscription-list and select certain names to be excepted from the operation of the rule.

One subscriber writes that he 'shouldn't think it would pay?' Perhaps it does not. Nevertheless, we have not time to look after the small number of subscribers who fail to renew each year. No doubt if we had no other work it would pay to do so. As it is, we assume that every subscriber who wants the JOURNAL will take it.

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**MICROSCOPICAL SOCIETIES.**—The officers and members of microscopical societies are requested to aid us in preparing a list of such societies in the country for publication, as explained last month. It is desired to make the list as complete as possible, but no society will be entered in the list until we have definite information concerning its active existence, which should properly come from the Secretary or President. We do not intend to copy from any old lists, as it is only desired to publish the

names of societies in existence each year. As yet we have very few responses to our request last month. If the Secretaries are not sufficiently interested in this matter to enable us to make a reasonably complete list (which only demands a few moments of the time of each one), we will be obliged to postpone it indefinitely.

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### OBJECTIVES FOR SPECIAL USE.

The wide-spread interest in the study of bacteria with reference to their morphology and their association with diseases, has called forth many private letters to the editor inquiring what objectives are the most suitable for such investigations. In view of the importance of this subject to many readers, we propose to offer a few remarks in this place, but with much diffidence, since our personal experience in this particular kind of examinations has been extremely limited.

In the first place we would say that we cannot understand why an objective of extreme angular aperture should be required for this work. It would seem that what is wanted is not angular aperture but extreme sharpness of definition, which can be obtained quite as well with lenses of moderate angular aperture. Whether this is true or not we are not prepared to assert in positive terms, but so far as our experience goes it seems to be so. Yet the fact is, that those who are practically engaged as investigators prefer the high-power, homogeneous-immersion, wide-angle lenses. For this reason we hesitate to advise the purchase of any others for this kind of work, although we can scarcely resist the impression that the advantages of the homogeneous-immersion lenses are due in great part to their excellence as optical instruments, rather than to their large angle. As is well known, the use of oil as an immersion medium gives no little advantage to the maker, and there is no doubt its benefits are felt equally well in the making of lenses of moderate angular aperture.

As regards this matter it may also be said that it is not usual for investigators in this field—at least so far as we are aware—to use oblique light for illumination. The Abbe condenser is used very largely, but probably it finds its greatest application in the study of sections of tissue, in which the organisms are distributed and stained. A flood of light from the condenser thrown upon such a preparation makes the tissues almost invisible, and causes the deeply colored bacteria to stand out with wonderful clearness. But this is not due to the angle of the objective. The condenser is useful in this work more on account of the control it gives over the light than for the angular illumination it is capable of giving. If we are in error concerning this matter we would be glad to have some more practical observer correct us.

As regards our own experience, we have yet to see anything more of bacteria with a homogeneous-immersion lens than with a  $\frac{1}{12}$  by Spencer, glycerin-immersion. What few observations we have made have mostly been conducted on mounted specimens, and the Spencer  $\frac{1}{12}$  was carefully compared with a Zeiss  $\frac{1}{12}$ , without any noticeable difference. Yet on *Amphipleura* the Zeiss is far superior to the other.

So much for the ordinary study of the bacterial organisms. From this we may pass to a very brief notice of another kind of observation, requiring the greatest skill of the observer and objectives of the highest excellence. Dr. W. H. Dallinger stands almost alone in the thorough study of the life-history of certain monads. His opinions, therefore, are of great weight concerning the best objectives for such work. In his address as President of the R. M. S. of London, published in the April number of the *Journ. R. M. S.*, he states that for continuous observation of monads he uses only dry lenses, a  $\frac{1}{16}$  a  $\frac{1}{8}$  a  $\frac{1}{6}$  and a  $\frac{1}{50}$  being the favorite ones, the

$\frac{1}{35}$  being chiefly used. He then says: 'But beyond the work of continuous watching, when the opportunity presents itself, there is the work of developmental morphology, of discovering all the details of the adult form, and of thoroughly demonstrating the changes that ensue in the completion of the life-cycle. It is here that first, water immersion, and now, above all, homogeneous lenses have been to me of untold value.' He has used in his investigations a  $\frac{1}{12}$  N. A. 1.47, a  $\frac{1}{25}$  N. A. 1.38, a  $\frac{1}{30}$  N. A. 1.38 and a  $\frac{1}{8}$  N. A. 1.50, all by Powell & Lealand. Of all these we should infer that the  $\frac{1}{8}$  is regarded by Mr. Dallinger as superior to the others. This work of Dr. Dallinger is of the most refined and delicate character, involving the detection of the extremely delicate long flagella with which the organisms are provided, as well as the study of the structure of their bodies.

We have presented this matter for the consideration of those who may be interested, and in conclusion we can only say that the weight of evidence from practical observers indicates that there are advantages in the use of homogeneous-immersion objectives for the study of bacteria; but whether these are due to the wide angular aperture or to excellence of construction we are not prepared to say.

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ELECTRIC ILLUMINATION.—There are continually coming into notice new devices in lamps and batteries for electric illumination for medical and microscopical purposes. Considerable advance has already been made in the matter of electric illumination applied to the microscope, as the pages of this JOURNAL in the past have shown. But it must be confessed, much still remains to be done before one can sit down to a microscope in his home, and turn on the electric light like gas-light. Perhaps it is too much to expect quite so great convenience, yet if it is to be brought



into general use it must be reasonably convenient, and it must not be far removed from a kerosene lamp in this respect. It is true there are decided advantages in the excellence, purity and brilliancy of the electric light, which make it very desirable. Nevertheless, these advantages are not so great as will induce observers to put up with the nuisance of ordinary batteries.

Among those who have been quick to recognize the value of the electric light in microscopy is Mr. Edward Bausch, who, in the spring of 1882, became interested in the subject, and in that year made use of an electric attachment at a public exhibition of the Rochester Academy of Sciences constructed substantially like that now made by Messrs Bausch & Lomb. Later in the same year it was shown at the meeting of the American Society of Microscopists, at Elmira. Mr. Bausch believed that his application of the electric light to the microscope was new, and he therefore applied for letters-patent, which were granted May 22d, 1883. To Mr. Bausch belongs the credit of having quickly appreciated and practically applied a source of light which is sure to grow in popularity, when suitable batteries are devised.

A number of different kinds of batteries have been made already, and as we may expect some of them to be offered for microscopical use, it may be well at this time to mention some facts about batteries in general.

In the first place it does not seem to us advisable to recommend any battery that will not run a one candle power lamp at its full brightness at least three hours without intermission. This can easily be done with a large battery—one which exposes considerable surface of zinc and carbon, and holds considerable fluid. But a large battery of even one or two cells is only desirable when one can store it out of the way, and use it always in one place.

The problem is, how to make a

lasting small battery. This has not yet been accomplished, so far as we have heard; but there are several promising devices under way, which may lead to a solution of the problem.

Among the large batteries we were well pleased with a couple of cells which were recently at work in Mr. G. S. Woolman's establishment at New York. These gave a very good light, which would probably last many hours.

Passing to the other extreme, there are offered very small batteries, scarcely larger than an ordinary collar-box, which are said to give a good light. Such batteries are practically useless for microscopical work. The production of electricity involves the consumption of a certain amount of zinc and battery fluid, and a very small battery cannot furnish enough of either. The amount of electricity produced in a given time depends upon the rapidity of the chemical action in the battery, and this is largely dependent upon the extent of surface exposed. It seems likely that a satisfactory battery will be made which will go in a box of a cubic foot capacity, this space allowing for the removal of the zincs from the fluid when not in use. One can scarcely expect anything smaller than this that will be convenient for use, unless new combinations of fluids are employed, of which we may hear more anon.

We would advise all purchasers of batteries to be careful about choosing their lamps. There is a great difference in lamps of different makers, some requiring far more battery power to run them than others. The Edison lamps are good.

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## NOTES.

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—Mr. R. D. Nevins, of Olympia, Washington Territory, has sent us some beautiful specimens of a marine plant covered with diatoms. One specimen is thickly spread with *Arachnoidiscus*, and the other has the same diatom and many others, including *Isthmia* and *Tricera-*

tium. Readers who desire some of this material for mounting would do well to send a good preparation of some kind to Mr. Nevins as an exchange.

— The first annual soirée of the Washington Microscopical Society was given at the Washington High School building on the evening of March 24th. It was attended by a large number of persons, who had never before seen such a display of microscopes and apparatus. There were forty-three microscopes on the list, and the Bausch & Lomb Optical Company sent several of their new stands for exhibition, which were greatly admired. There is not much to be said about the exhibition, it being no different from others of the kind—a collection of fine, showy objects, of all kinds, along with some others of a more special interest, among which we may mention the bacilli of tubercle, and of cholera, and some very fine sections of fish-eggs made and exhibited by Mr. John A. Ryder. The printed program was far from creditable to the society, being replete with egregious blunders, such, for example, as 'Bacilli' instead of Bacillus, and 'Lepido syren' instead of Lepidosiren. We trust more care will be exercised in this respect on future occasions of the kind. An abstract of the address of Prof. Seaman is printed on another page.

— The Rev. Mr. Wolle is engaged upon a comprehensive work treating of the freshwater algæ of the United States. It will be illustrated with about one hundred plates, of the same character as those in his work on the desmids. About fifty plates are already drawn. Mr. Wolle has been spending a short time in Florida, where he has doubtless found a rich field for collecting algæ.

— Mr. Henry Mills recently favored us with a call on his way home from Florida. He has found sponges in the fresh-water streams abundant there, although it is the general impression that they are not common in that state. We hope to receive from him an account of his sojourn there, before long.

— We have received some sample glass slips from Messrs. Emmerich & Son, which they are offering at \$2.00 per hundred, if we are not mistaken in the figures. They are made of very white and clear glass, quite thin, and polished on the edges. We should say they were very good slips indeed. They are probably made in Germany.

— We notice the Liverpool (Eng.) Microscopical Society has adopted the new time. The council now meets at eighteen o'clock, they have tea and coffee at eighteen thirty, and the chair is taken at nineteen o'clock precisely. A very little calculation doubtless enables the members to reduce these figures to ordinary watch-time. It is quite right that scientific societies should take the initiative in this matter, and if we are to have the new plan (which is old enough among astronomers and navigators) let us aid in its immediate introduction.

— At a recent meeting of the New York Pathological Society bayberry-tallow was recommended for embedding tissues for sections. A writer in the *Louisville Med. News* in a report of the meeting says:—

'It is obtained from the ordinary bayberry-bush, and is used by furniture manufacturers for oiling the sliding surfaces of bureau-drawers, etc. They claim for the bayberry-tallow that it is cheaper and better than celluloidine, and far superior to paraffine and other kinds of wax heretofore used. A special feature claimed for it is non-solubility in alcohol, except when warmed to about the temperature of the body or a little above it, and hence the specimen may be kept indefinitely in alcohol at ordinary temperatures. Another count to the credit of the new tallow is that tissues injected with it or embedded in it can be shaved in thinner sections than those allowed by other materials, and that on account of its firmness it allows of a more even cut. After making a section the tallow may be removed from the specimen by simply placing it for a few minutes in a bath of warm alcohol. The exhibitor took occasion to mention the usual precaution that in heating the alcohol it must not be held over a flame, etc. The specimen presented with the paper was a section of the smallest bronchi, which showed up beautifully under a low magnifying power.'

— The old and rather worn-out controversy of monoculars *vs.* binoculars bids fair to be gone over again in the columns of the *English Mechanic*. Perhaps it is well to have such discussions occasionally. It refreshes one's memory concerning many little points (microscopic in more than one sense), and reminds us that there are differences of opinion on every subject. If any reader is uncertain which kind of a stand is the better, we would advise him to try both.



—In addition to their objectives a new price-list of which was received a short time ago, Messrs. H. R. Spencer & Co. now offer two microscope stands, which they designate as 'Nonpareil' No. 2 and No. 4, respectively, with one-inch and quarter-inch objectives, for \$42.00 and \$49.00. They consider the stands to be 'the best low-priced stands made in the United States.'

—Mr. W. H. Curtis has favored us with two neatly mounted preparations of diatoms; one a slide of five selected and arranged frustules of *Arachnoidiscus*, the other a mount of some fresh-water gathering. The diatoms are well cleaned and the mounting is well done, but highly ornamental. Between two fine rings of bright red color surrounding the specimens a white ring is made in which the preparer's name is written with a needle-point. Outside of this, around the edge of the cover-glass are dots of red and blue. The ornamentation is of the same kind as that on slides prepared by Mr. W. C. Walker.

—Another microbe of diseases has been brought to notice by the researches of Boniet, who has cultivated, through six generations, the microbe of mumps. It is still possible (not to say probable) that inoculation experiments will not fully sustain the supposition that they are the cause of mumps. Thus far only rabbits have been subjected to such experiments, and the results have been negative.

—Reports of the meetings of the San Francisco Microscopical Society come to us regularly, with much interesting matter. The society seems to be in a flourishing condition. At the meeting of March 11th, Dr. S. M. Mouser exhibited his newly acquired microtome of the Thoma pattern. It consists essentially of a frame of cast-iron, on which slide two carriers. A large and finely-finished knife is clamped to one of these, which slides on a horizontal plane. The second carrier (which holds the specimen to be cut) moves on an inclined surface.

Professor Thoma has based the construction of this microtome upon the principle (first theoretically deduced, and then practically demonstrated) that a body sliding between two inclined planes and touching the latter at five points only will slide evenly and exactly over such planes

even if they be not geometrically true. A knife attached to such a carrier will, therefore, always cut perfectly parallel sections of an object which is elevated after each cut. As a practical exemplification of the perfection with which the above principle has been worked out in the Thoma microtome, it may be stated that it permits the cutting of serial sections of well-hardened animal tissues of certain kinds as thin as .002 mm. (.0008 in.), and even such a comparatively coarse tissue as liver can, if well hardened, be cut to .01 mm. (.004 in.) The ability to produce sections of such wonderful delicacy has given a great impetus to histological and pathological research of late.

Mr. Breckenfeld exhibited a Graduated Blue-Glass Modifier, which has just been brought out by the Bausch & Lomb Optical Company. It consists of a glass disk revolving upon an adapter under the stage of the microscope. It is flashed from clear glass to dark blue, and one-half of its surface being lightly ground, any desired tint of field may be obtained, from white to deep blue, either transparent or translucent, by merely revolving the disk.

—The semi-monthly meeting of the San Francisco Microscopical Society was held March 25th. Dr. C. P. Bates exhibited an ingenious and efficient warm stage, for use in the study of pure cultures of bacteria and similar minute organisms. A sterilized cell containing the material under observation is laid upon a wooden slide which rests upon the stage of the microscope. This slide has a central perforation for admitting the rays necessary for illumination, and is heated by two twisted copper wires, which form a loop directly under the culture cell, and then, passing out of the slide at either end, meet directly in front of it, and are there again joined and prolonged a distance of several inches. The free end is made to pass through the perforated chimney of a small lamp, and by adjusting the flame of this along the wire the temperature of the culture cell may be raised or lowered until the desired point is reached. A delicate thermometer, adjustable on the slide, registers the temperature with great exactness. By the peculiar arrangement of the wires, the entire slide is heated with absolute uniformity, and in this respect it is a modification of, and somewhat of an improvement upon, a warm stage recently described in the *Journal* of the Royal Microscopical Society.

## CORRESPONDENCE.

### Pollen-Tubes.

TO THE EDITOR:—Without entering the discussion, I am glad to see your article on 'Pollen Tubes' in the February issue of the AM. M. MICR. JOURN., extending that courtesy to the researches of Mr. J. Kruttschnitt which is due to every earnest searcher for the true in science. Knowing somewhat of Mr. Kruttschnitt's earnest work for facts, I certainly should think twice before speaking once on points wherein we might differ.

When discussing the subject on our stage we should be careful not to enlarge the object at the other end of the tube. The search for truth in science calls for a very strong abnegation of self, and the same may be said of scientific discussions.

G. C. TAYLOR.

## NOTICES OF BOOKS.

*The Microtometist's Vade-Mecum.* A handbook of the methods of Microscopic Anatomy. By Arthur Bolles Lee. Philadelphia: P. Blakiston, Son & Co., 1012 Walnut street. 1885. (Pp. 424. Price \$3.00.)

The word 'microtomy' was first introduced by Mr. John A. Ryder in an article published in this JOURNAL last year. It has rapidly grown in favor, and we now have the microtometist's vade-mecum, one of the most useful books for the working microtometist or microscopist in the English language. The aim of the book is to put into the hands of the worker 'a concise but complete account of all the methods that have been recommended as useful for the purposes of microscopic anatomy.'

Part I treats mainly of the methods of fixing, staining, hardening, imbedding, injecting, etc., being a compendium of formulas, systematically arranged, covering 300 pages.

Part II is a description of special methods. This part is invaluable to the student, giving as it does the methods used by various investigators for special purposes, in a convenient form for reference. Thus, the methods of studying cell-division, karyokinensis, and embryological methods are given in chapters xxxiii and xxxiv, at the beginning of this portion of the work.

To render the book valuable to the beginner as well as the advanced worker

introductory paragraphs are added to different chapters, and examples to guide the learner in his experiments. We have not space for a more detailed notice of the work, but cannot refrain from calling attention to the author's unqualified condemnation of the freezing microtome for zoological work (p. 169). The book should be in the hands of every working microscopist.

*Our Living World.* An Artistic Edition of the Rev. J. G. Wood's Natural History of Animate Creation. Revised and adapted to American Zoology by Joseph B. Holder, M. D., F. N. Y. Acad. Sci.; Member Soc. Nat. E. U. S.; Member Amer. Ornithologists' Union; Curator of Vertebrate Zoology, American Museum of Natural History, Central Park, New York. Fully illustrated with scientific accuracy. New York: Selmar Hess. (4° Complete in 42 parts. Price 50 cents each part.)

Parts 1 to 8 of this elegant publication have been issued. They are beautifully illustrated, and the descriptions of animals and their habits are very interesting as well as instructive. The work is a popular natural history, and as such deserves, and will undoubtedly have, a large sale. The publisher states that 'the illustrations, with few exceptions, have never appeared in an English publication before—those of mammals being the results of the latest drawings by Frederick Specht.' The colored plates are from Brehm's Thierleben, reproduced by Prang & Co.

The work begins with an account of the quadrumana or monkey tribe, and has a fine colored plate of gorillas and another of the chimpanzee, with numerous woodcuts.

The body of the work has been studiously preserved in a simple and readable form, and the more strictly scientific portions have been removed to a 'Compendium of Generic Distinctions' at the end of each volume. In this Compendium the reader will find a brief notice of the various characteristics which are employed by our best systematic naturalists for the purpose of separating the different genera from each other; and by its aid he will be enabled to place every animal in that position which it is at present supposed to occupy.

The complete work will form three handsome volumes of royal quarto size, and contain forty-two oleographs, eighty-four full-page wood engravings, and very nearly a thousand more scattered through the text.



# THE AMERICAN MONTHLY MICROSCOPICAL JOURNAL.

VOL. VI.

WASHINGTON, D. C., JUNE, 1885.

No. 6.

## The Microscopical Examination of Tea.

Tea is the leaves of *Thea sinensis*, an evergreen, native in China, Japan and Eastern India. A few years ago teas were greatly adulterated in China, and more or less after importation, but at the present time it is not an easy matter to find teas adulterated with other leaves. The leaves that have been used, according to testimony more or less trustworthy, are the willow, elder, sloe, and many others, and exhausted tea-leaves.

Green and black teas are obtained from the same plant, the differences in appearance and flavor being due to the methods of preparation. To give the leaves an attractive appearance they are sometimes faced with coloring matters, such as plumbago, Prussian blue, soapstone, turmeric and other harmless compounds. Such additions cannot be regarded as adulterations; but occasionally sand or solid particles in excessive quantity are found, obviously added to increase the weight.

The microscopical characters of the tea-leaf are such as to enable the observer to distinguish even small fragments with certainty. The leaves should be treated with hot water and then spread out on a smooth surface, such as a plate of glass, and examined with a hand-lens to make out the venation. This is quite peculiar in the tea-leaf, the veins spreading from the midrib, forming closed, oblong loops within the margin of the leaf, and oblong meshes on either side of the midrib.

The margin is distinctly toothed, and more or less emarginate at the

apex. Each serration ends in a short spine, more or less curved inwards.

For perfectly satisfactory examination of the microscopic structure the leaves require some preparation, since they are too thick, and too close in texture, to make good objects for study in their natural condition. However, one who is familiar with their structure can identify the leaves very well after they are softened in water and prepared in glycerin.

The under surface of the tea-leaf is shown in Fig. 14. It consists of numerous stomata among the curious,

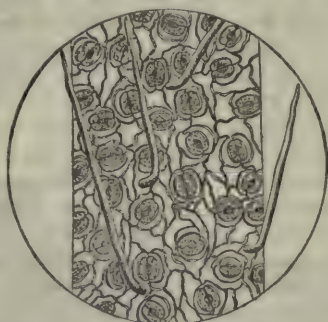


FIG. 14.—Under surface of Tea-leaf.

irregular, outlined cells, and simple hairs. The upper surface bears no stomata, and the cells are similar to those of the under surface, but smaller. The interior of the leaf is made up of fibro-vascular tissue, and cells filled with chlorophyll, the latter shown at A Fig. 15. There are also some peculiar branched cells like that shown at c in the same figure.

To study the epidermis to advantage it may be readily removed by boiling in water acidified with nitric acid. The epidermis is thus made to peel off

in large pieces, which may be stained and mounted in balsam, or else

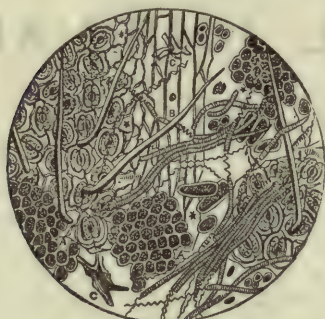


FIG. 15.—Ground Tea.

mounted in dilute glycerin without staining, as we prefer.

Another method of making the structure of leaves visible under the microscope may also be employed in these examinations. Place a portion of the leaf on a slip of glass, spread out flat, cover it with thin glass, and place a coin on top for a weight. Moisten it with a few drops of an alkaline solution of potassic permanganate and heat carefully to boiling. Wash with water and then let a few drops of hydrochloric acid flow under the cover-glass, to dissolve the oxide of manganese which was formed in the tissues by the previous boiling. Then wash again with water. The protoplasm is thus destroyed, and only the more firm cellulose membranes remain, showing perfectly the structure of the leaf.

Still another method is to carbonize the leaf by heating it, covered with thin glass, weighted as before, on a strip of platinum. The ash thus remaining retains the form of the leaf.

To detect the facing on the leaves it is only necessary to examine them dry by reflected light, when the minute particles will be readily seen under a low-power. By boiling the leaves in water the particles of mineral matter are detached, and on standing will sink to the bottom as a fine sediment, which may be examined.

## Microscopical Exhibits at the New Orleans Exposition.

BY L. W. CHANEY, JR.

The display of microscopical apparatus which the exposition called forth was not a little disappointing—not in the quality of the exhibit, but in its extent. But two firms made exhibits of microscopes and apparatus of sufficient importance to challenge attention. There may have been others, but four weeks of diligent search failed to reveal them. The firms referred to were the Bausch and Lomb Optical Company and the McIntosh Galvanic Company. The first-mentioned doubtless manufacture the fullest line of optical goods of any firm in this country. Their exhibit, although unfortunately placed and too crowded to show to the best advantage, was of great interest and excellence. Their stands are as a whole good representatives of what has been called the American model. They have neither the clumsy complication of some of the large English models nor the severe plainness characteristic of the Continental forms. There is doubtless an evolutionary process going on in this matter by which we are attaining the form best suited to our needs. Their 'universal' stand particularly attracted attention. It seems in many respects to deserve its name. It may be reduced to a simplicity which would almost command the approval of the admirer of German style, and at the same time is capable of development in various ways which add much to the ease and rapidity of manipulation. The glass stage and slide-carrier, which may be applied to this and other stands, is an admirable contrivance. It has one marked advantage over the forms held down by ivory points, in that it maintains its position much better when the instrument is placed horizontal.

At the time of my visit they did not have a full display of objectives, the homogeneous-immersion series not being represented. As they claim



much for their objectives of this class, I was disappointed at not being able to test the performance of some of them. The best test of an optician's skill is the making of thoroughly good lenses which can be sold at moderate prices. Judged by this test, the Bausch and Lomb Company have achieved a gratifying success. Having used their 'student series' side by side with similar objectives of foreign make, I am convinced that it is scarcely possible to secure more satisfactory work for the same price, and that it is very possible to get poorer.

Much more might be said of their general exhibit, but there was one feature worthy of special attention. I refer to their newly-produced microtome. This is almost a new departure in this country, but one other maker having attempted the production of such a machine. The model shown at New Orleans was a tentative one, and has since been much modified and improved. It differs from the foreign model most familiar in this country in that the object-holder has a vertical motion, imparted by a micrometer screw working in the bed of the machine, instead of moving upon an inclined plane. The object-holder is firm, and has universal motion on three axes. The micrometer

represent an upward movement of the screw of  $\frac{1}{2000}$  of an inch. It is thus easy by the clicks of the catch to determine the thickness of the cut section. The triangular, prismatic block carrying the knife moves along the side of an upright rising from the centre of the bed. It is held steadily in place by a weight fastened to the end of a bent arm extending over the side of the way. This throws the centre of gravity below the way and gives great steadiness. For some reason this feature has been abandoned in the later forms.

Whether the extreme delicacy of work possible with the Thoma microtome can be secured with this can only be settled by trial. So far as can be judged by observation without experiment good services may be expected from the Bausch and Lomb machine. It would seem desirable that metric units should be used in their micrometer screw, since not a few American students already find metric expressions more readily intelligible than fractions of the inch.

The McIntosh Galvanic Company,

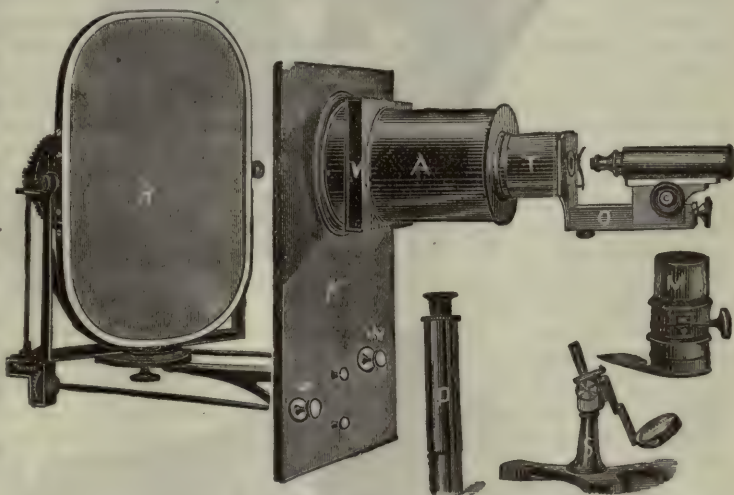


FIG. 16.—Dr. McIntosh's Projection Microscope.

screw is actuated by a large head or wheel, upon whose edge are notches into which a catch falls. These notches are so spaced as to

of Chicago, have a large exhibit of their manufactures, including Dr. McIntosh's projection microscope. The accompanying cuts give an idea

of the arrangement of parts, and of the appearance of the instrument when arranged as an ordinary stand. Dr. McIntosh has spent most of the

winter in New Orleans and has had a place fitted up in the space occu-

pied by his exhibit in which to show his instrument. I spent a pleasant hour with him, and came away with an impression that the resources and adaptability of projection were not fully comprehended as yet by microscopists. For the making of drawings it is greatly to be preferred to the camera lucida in any form, while for continuous study of a preparation it has a double advantage in giving a larger field than can be viewed with the eye-piece, and being much less wearisome to the eyes.

Aside from the exhibits mentioned above, the only ones interesting to microscopists are the photo-micrographs taken by Dr. Woodward and Dr. Sternberg. These include all the common test objects

and many histological and pathological specimens. The clear definition and general excellence of these productions are worthy of all praise, show what can be done in this line, and justify what seemed presumption before the attempt was made. To secure pictures as good as some of these with an amplification of 6,000 diameters is no small achievement of skilful and delicate manipulation.

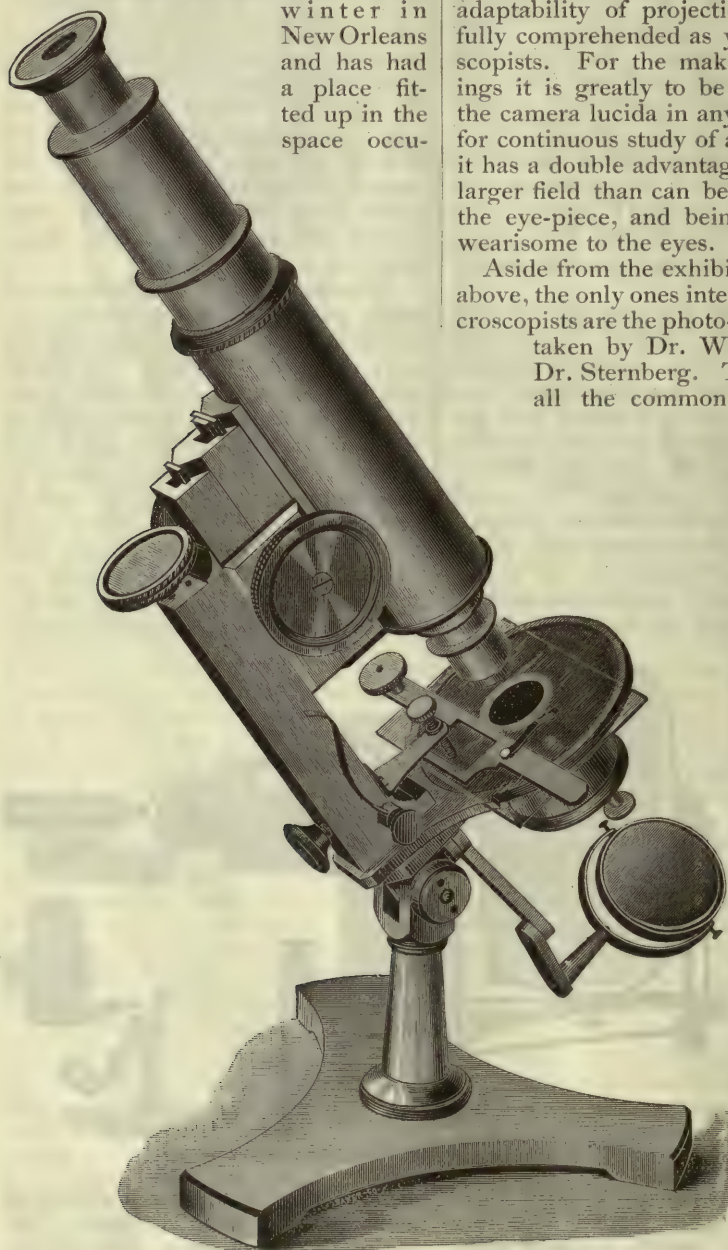


FIG. 17.—McIntosh Galvanic Company's Microscope.



### A Collecting Bottle.

We illustrate this month a device for collecting, which was described more than a year ago in the *Journal* of the Royal Microscopical Society, but which was crowded out from our columns at the time. The apparatus scarcely requires any description. It

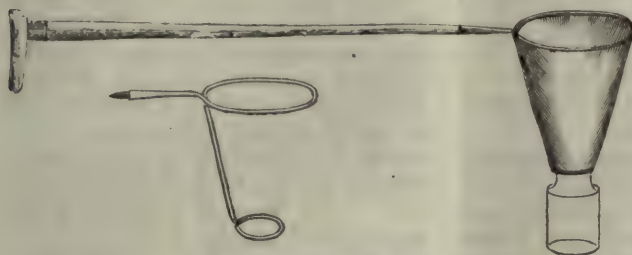


FIG. 18.—A Collecting Bottle.

consists of a light wire frame covered with muslin, made to grasp the neck of the bottle. It is attached to a rod or walking-stick. The wire keeps the muslin stretched, which is a great advantage, as those who have had experience in collecting will readily understand.

For the benefit of those who have not had experience in collecting it may be said that the organisms in pools of water are usually found in greatest abundance living among the vegetation along the borders and at the bottom, or in the masses of algæ which float on the surface. They should be secured by scraping along the plants and washing the finds down into the bottle, from which they are easily transferred to smaller vials for convenience.

### Orthocarpus Purpurescens.

The seeds of *Orthocarpus purpurescens* possess marked characteristics of interest to the microscopical observer. The plant which furnishes them is a native of California, where it appears in early spring, usually in large patches. The genus *Orthocarpus* belongs to the family Scrophulariaceæ and is represented by nine or more species in California. Of

these *O. purpurescens* is one of the largest and most showy. It is a low plant about six inches high, usually strict but sometimes branching and bearing a spike of small crimson flowers and colored bracts. The blossoms are much visited by insects for the sake of the contained nectar.

The ripened seeds are shaped like a truncated cone about 0.75 mm. broad and 1.25 mm. long. It is at once observed that they present a punctated appearance and in certain positions reflect light strongly.

Placing some of the seeds in a shallow cell on an object slide, and transferring the same to the stage of the microscope, we examine them by reflected light, with a three-inch or two-inch objective. Behold, a revelation! That which we saw glitter is a latticed capsule, reminding us of the Radiolaria, and the seed itself is a plummet-shaped brown body safely lying within. If some of the seeds are comparatively green we may see that some of the interstices are yet closed by a thin membrane.

Examining by various methods of illumination we discover that a charming effect is brought out by the dark ground illumination. The latticed network inclosing the seed now shines like crystal. This resemblance is enhanced when on trying the polariscope we find that the capsule acts on polarized light. The use of a suitable selenite is desirable. This reaction to polarized light appears to prove that the trabeculæ of the capsule are largely composed of silica. What purpose the capsule may subserve remains as yet unknown.

Few, if any, seeds can equal these in varied microscopic interest, and they are heartily commended to all observers.

EDWARD GRAY,

[We have received a beautiful pro-

paration of these seeds from Dr. Gray, such as he is offering in the Exchange column. The lattice-work capsule is beautifully shown under a 2-inch objective, and makes a most attractive object for exhibition.—ED.]

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### Staining Tissues in Microscopy.\*— III.

BY PROF. HANS GIERKE.

[Continued from p. 94.]

#### HEMATOXYLIN, EXTRACT OF LOGWOOD.

36. Waldeyer. Untersuchungen über den Ursprung und den Verlauf des Achsencylinders bei Wirbeltieren und Wirbellosen. Henle und Pfeufer's Zeitschr. f. rationelle Med. 3 Reihe. Bd. xx, p. 200.

Waldeyer tried to stain the central axis of nerves with carmine and anilin and also with logwood, alkanet and Brazil wood. He obtained good results only with alkanet. The watery extract of both dye-woods stained too deeply, and did not differentiate the axis.

37. Böhmer. Aerztl. Intelligenzb. f. Baiern, 1865. No. 38.

1. Hematoxylin in crystals, 0.35 gm.; absolute alcohol, 10.0 gm. Dark brown fluid; does not spoil.  
2. Alum, 10 gm.; distilled water, 30.0 gm.

Add a few drops of No. 1 to No. 2, according to the strength desired. The result is a deep bluish violet fluid. The first solution improves with age. The mixture should be made three or four days before using, and exposed to the light, or it will stain too darkly. The fluid keeps well, but requires filtering in summer. It dyes specimens hardened in chromic acid as well as in alcohol, but requires care to prevent over-staining. If this happens, acids—especially acetic acid—may be used to wash out the excess of color, but

preparations thus treated are less permanent, and in the course of years some bleaching takes place, especially when chromic acid has been used.

38. Frey. Die Hematoxylin farbung. Archiv. mikrosk. Anat., Bd. iv, p. 345.

Frey recommends Böhmer's fluid. For preparations hardened in chromic acid, potassium bichromate, or copper sulphate the alum may be omitted; the alcoholic solution of hematoxylin is merely diluted with water. Frey thinks the action on chrome preparations is similar to that of Leykauf's ink. (See Wagner's Chem. Technol., 3 Aufl., p. 532.)

39. Merkel. Der quergestreifte Muskel. Arch. mikrosk. Anat., Bd. ix, p. 293.

The double refracting portions of muscular tissue stain readily with extract of logwood; other parts remain uncolored.

40. Arnold. Logwood as a staining material for animal tissues. Quart. Journ. Micr., 1873. p. 86.

Rubs up logwood with three times as much alum, digests in water, and adds one-fourth as much 25% alcohol. (Can only take the place of Böhmer's fluid when no crystals are to be obtained.)

41. Lawson Tait. Journ. of Anat. and Physiol., vol. ix, p. 250.

Recommends that preparations stained with hematoxylin should be treated with 4% nitric acid. The nuclei will then show brown on a cherry red ground. (Preparations thus treated soon bleach out.)

42. Kleinenberg. In 'Grundzuge der Entwicklungsgeschichte der Thiere,' by Foster and Balfour. Leipzig, 1876.

Three solutions are to be made:—  
1. Saturated solution crystallized calcium chloride in 70% alcohol, to which add as much alum as it will dissolve.  
2. Saturated solution of alum in 70% alcohol. Mix 2 with 1 in the pro-

\* From the *Zeitschrift für wissenschaftliche Mikroskopie*. Translated for this JOURNAL by Prof. Wm. H. Seaman, M. D.



portion of 8 to 1. 3. Concentrated solution crystals of hematoxylin in alcohol or in No. 1, and add a few drops as required to the mixture of 1 and 2. (Especially recommended for embryos, and very satisfactory.)

43. Alleyre Cook. Note on logwood staining solution. *Journ. of Anat. and Physiol.*, vol. xiv, p. 140.

Extract logwood, 6 pts.; alum, 6; copper sulphate, 1 pt.; water, 40 pts.; thymol, a small crystal. Rub the first three well in a mortar, add water to a thin paste, stir occasionally for two days, filter, and add the thymol to preserve it.

The solution acts on material fresh and hardened in alcohol. For chromic acid preparations use eight drops of the above tincture to 120 of water and one of a 1% solution of potassium bichromate. For mounting in balsam wash well in absolute alcohol to prevent bleaching.

(Bleaching will occur more or less. The solution of bichromate is too weak to be effective. The dilution is 1 to 130,000.)

44. P. Mayer. Ueber die in der Zoologischen Station zu Neapel gebräuchlichen Methoden zur mikroskopischen Untersuchung. *Mith. d. Zool. Stat. Neapel*, Bd. iv, p. 1.

Kleinenberg's method is highly recommended and is modified slightly by adding one volume of strongly-concentrated solution calcium chloride and alum in 70% alcohol to 6-8 of spirit of the same strength. To this is added as many drops as required of a solution of hematoxylin crystals in absolute alcohol.

45. Renault. Sur le mode de préparation, et l'emploi de l'éosine, et de la glycérine hematoxylique en histologie. *Arch. de Physiol.*, 1881, p. 640.

A thick neutral glycerin is saturated with alum, and about one-fourth as much of an alcoholic solution of hematoxylin added drop by

drop. Too much causes a precipitate, and the alumed glycerin must be added to clear up; filter and set in the light for some weeks, till no smell of alcohol is perceptible; filter again, and it is fit for use, and will keep well. It dyes in five to ten minutes. Renault uses a few drops as a mounting fluid.

(We find the color leaves the fluid and goes into the preparation, which is therefore very good. At first, however, the uniform color renders the objects less distinct and transparent.)

46. Dippel. *Das Mikroskop*, 2 Aufl., 1882. Bd. i, p. 719.

Kleinenberg's method is herein simplified. A saturated solution of chlor-aluminium is diluted by 6-8 volumes of 70% alcohol. Alcoholic solutions are recommended. A mixture of alcohol, alum, and hematoxylin solution diluted with 50-70% alcohol or water is also described.

47. Friedländer. *Mikroskopische Technik*. Berlin, 1882, p. 43.

A process similar to Renault's is here described, which only differs by the use of determined volumes, as follows: Hematoxylin, 2.00; alcohol, 100.00; distilled water, 100.00; glycerin, 100.0; alum, 2.0 gm.

(Hematoxylin is very much used in double staining, which see.)

48. Rindfleisch.

Uses concentrated watery solutions of hematoxylin and alum. Pour the first into the second.

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### The Sizes of Blood-Corpuscles.

Professor Theodore G. Wormley, in the new edition of his work, gives the following sizes of blood-corpuscles, as measured by himself and Professor Gulliver. We have only copied the sizes for mammals and birds. It will be seen that, with three or four exceptions, the sizes obtained by the two observers are practically the same:

Mammals.	Wormley.	Gulliver.
Man, . . . . .	1-3250	1-3260
Monkey, . . . . .	1-3382	1-3412

Mammals.	Wormley.	Gulliver.
Opossum, . . . . .	1-3145	1-3557
Guinea-pig. . . . .	1-3223	1-3538
Kangaroo, . . . . .	1-3410	1-3440
Muskrat, . . . . .	1-3282	1-3550
Dog, . . . . .	1-3561	1-3532
Rabbit, . . . . .	1-3653	1-3607
Rat, . . . . .	1-3652	1-3754
Mouse, . . . . .	1-3743	1-3814
Pig, . . . . .	1-4268	1-4230
Ox, . . . . .	1-4219	1-4267
Horse, . . . . .	1-4243	1-4600
Cat, . . . . .	1-4372	1-4404
Elk, . . . . .	1-4384	1-3938
Buffalo, . . . . .	1-4351	1-4586
Wolf, (prairie), . . . . .	1-3422	1-3600
Bear, (black), . . . . .	1-3656	1-3693
Hyena, . . . . .	1-3644	1-3735
Squirrel, (red), . . . . .	1-4140	1-4000
Raccoon, . . . . .	1-4084	1-3950
Elephant, . . . . .	1-2738	1-2745
Leopard, . . . . .	1-4390	1-4319
Hippopotamus, . . . . .	1-3560	1-3429
Rhinoceros, . . . . .	1-3649	1-3765
Tapir, . . . . .	1-4175	1-4000
Lion, . . . . .	1-4143	1-4322
Ocelot, . . . . .	1-3885	1-4220
Mule, . . . . .	1-3760	
Ass, . . . . .	1-3620	1-4000
Ground-squirrel, . . . . .	1-4200	
Bat, . . . . .	1-3966	1-4173
Sheep, . . . . .	1-4912	1-5300
Ibex, . . . . .	1-6445	
Goat, . . . . .	1-6189	1-6366
Sloth, . . . . .		1-2865
Platypus, (duck-billed), . . . . .		1-3000
Whale, . . . . .		1-3099
Capybara, . . . . .	1-3164	1-3190
Seal, . . . . .		1-3281
Woodchuck, . . . . .		1-3484
Muskdeer, . . . . .		1-12325
Beaver, . . . . .		1-3325
Porcupine, . . . . .		1-3369
Llama { Long diam. 1-3201		1-3361
{ Short " 1-6408		1-6229
Camel { Long diam. 1-3331		1-3123
{ Short " 1-5280		1-5876

## WORMLEY.

## GULLIVER

Birds.	Length.	Breadth.	Length.	Breadth.
Chicken, 1-1894	1-2080	1-3483	1-2102	1-3466
Turkey, 1-1894	1-3444	1-2045	1-3599	
Duck, 1-1955	1-3504	1-1937	1-3424	
Pigeon, 1-1892	1-3804	1-1973	1-3643	
Goose, . . . . .		1836	1-3839	
Quail, . . . . .		2347	1-3470	

## GULLIVER.

## Birds.

## Length. Breadth.

Dove, . . . . .	2005	1-3369
Sparrow, . . . . .	2140	1-3500
Owl, . . . . .	1736	1-4076

The subject of minute measurements was discussed in an interesting manner in an address before the Microscopical Section of the A. A. A. S. last year, an abstract of which was published in this JOURNAL, vol. v, p. 181.

The slight differences in size accurately given in this table are not always appreciable under modern amplification, but under a power of 1,150 diameters 'corpuscles differing by the 1-100000 of an inch are readily discriminated.' For the conclusions of Prof. Wormley as regards the possibility of identifying blood of different animals, the reader is referred to the brief review of Micro-Chemistry of Poisons, which will be found in another column.

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## Provisional Key to the Classification of Algae of Fresh Water.—II.

[Continued from page 74.]

### Family II. PROTOCOCCACEÆ Kirchner.

Vegetative cells without cilia, single or united in cœnobia. Propagation by copulation of swarm-spores, or by unsexual zoospores. No vegetative division.

a. The individual cells do not remain united, but live separately, or at the most, in families of irregular form. (EREMOBIAE.)

### Synopsis of Genera.

Cells single, angular, angles sometimes produced, slender, radiate.

*Polyedrium*, 31.

Cells single or in masses, starch-grain and vacuole. *Protococcus*, 32.

Cells green, irregular in shape, within water-plants—endophytic.

*Chlorochytrium*, 33.

Cells oval or elongate, attached by a pedicel. *Characium*, 34.



Cells like *Characeum*, contents contracted into a ball.

*Hydrianum*, 35.

Cells stiptate, in tufts. *Codiolum*, 36.

Cells cylindrical, curved, free.

*Ophiocytium*, 37.

*b.* Individual cells united in a cœnobium-like family, which, however, differs from a true cœnobium, in that their cells are not all of one and the same generation. Zoospores by simultaneous division. (PSEUDOCÆNOBLÆ.)

### *Synopsis of Genera.*

Elongate cells, spreading from end of mother-cell, forming tree-like families.

*Sciadium*, 38.

*c.* Individual cells united in cœnobium, or families of definite form, produced by the growth of daughter-cells of one and the same mother-cell. These plants differ from the multicellular algæ in that the single cells show no vegetative division. (CÆNOBLÆ.)

### *Synopsis of Genera.*

Elongate cells in series of 2-8 side by side.

*Scenedesmus*, 39.

Cœnobium globose, solid; cells angular, two spines at angles.

*Sorastrum*, 40.

Cells half-moon shaped, convex margins joined in cœnobium of 4-8.

*Selenastrum*, 41.

Cœnobium spherical, hollow, cells in a single reticulate layer near the surface.

*Cælastrum*, 42.

Cœnobium flat, round or oval.

*Pediastrum*, 43.

Cœnobium a net, formed of cylindrical cells placed end to end forming the meshes.

*Hydrodictyon*, 44.

Genus of doubtful value omitted (combined with *Characeum*, 34):—

*Hydrocytium*.

### *a. EREMOBLÆ.*

31. Genus *Polyedrium* Nägeli.

Cells single, angular, free swimming, three or more angled, the corners lying in one plane, or tetrahedral; contents chlorophyll-green, often with red spots.

Propagation by gonidia, 3-4 form-

ing of the contents of one mother-cell, which pass out through an opening in the wall, covered with a delicate envelope and grow separately.

Apparently some of the species here placed belong in the development-cycle of cœnobian protococcae, and correspond to the so-named *polyedern* of *Hydrodictyon* observed by Pringsheim, from which, by free cell formation, new hydrodictyonets develop.

[Some of the forms bear close resemblance to certain desmids, especially to members of the large genus *Staurastrum*. Their mode of propagation is quite different.]

32. Genus *Protococcus* Agardh.

Cells spherical, not attached, single or in irregular masses, with green or red contents, a starch granule and vacuole. Zoospores formed by successive binary division.

[The appearance of *Protococcus* is so very much dependent upon conditions, that it is not possible here to describe its many transformations. When in the water the cells may be actively swimming about, but most frequently it will be recognized as a thin, powdery layer of cells, or, in the presence of abundant moisture, the cells may be surrounded by gelatinous envelopes. It occurs on bark of trees, damp walls, etc., and seems to be not unfrequently confounded with *Pleurococcus*, which is found in similar places. It is, indeed, doubtful if the two genera are distinct, although *Pleurococcus* is seldom observed except in the vegetative condition, while *Protococcus* is more ready to pass into the motile condition in the presence of water.

It is more than probable that many of the plants included in this genus belong to the life-cycles of higher algæ.]

33. Genus *Chlorochytrium* Cohn.

Endophytic plant. Cells spherical, oval, kidney-shape, or 2-3- multi-lobed, single or in groups in the intercellular space of the parenchyma of water-plants. Numerous zoospores

are produced from the chlorophyllous contents, which escape through tubular projections, either into intercellular space or the surrounding water. Resting cells with thick walls have been observed.

[These plants have been found in *Lemna* and *Ceratophyllum*. They have not been observed in this country.]

### 34. Genus *Characium* A. Braun.

Cells always with one end attached, usually with a pedicel, of various forms. Propagation by zoospores formed by successive binary division within the mother-cells, escaping singly through a lateral opening in the cell-wall.

[The cell-contents are homogeneous or granular, finally breaking up into numerous oblong zoospores with two cilia, which fill the cell. When they escape they make their way to some plant in the water to which they become attached and grow into new plants like the parent.]

The Genus *Hydrocytium* A. Braun seems not to differ in any way from *Characeum*, and we have, therefore, omitted it. Rabenhorst describes a peculiar stellate arrangement of the zoogonidia, in which a number of the motile cells are united together by their ends in a radiate manner.]

### 35. Genus *Hydrianum* Rabenhorst

Cells as in *Characium*, but contents at first homogeneous, afterwards contracted into an ovoid green body, from which, by oblique division, 2-4-8 short zoogonidia are produced, each with two cilia, which escape by a terminal aperture.

[This genus may well be included under *Characium*.]

### 36. Genus *Codiolum* A. Braun.

Young cells obovate, later cylindrico-subclavate, stipitate, aggregated in tufts; contents green, finely granular, with numerous starch-granules.

Propagation by zoospores and resting spores (hypno spores.)

[This genus is found in both fresh and salt water.]

### 37. Genus *Ophiocytium* Nägeli.

Cells cylindrical, straight or variously curved, usually one end attenuated to a short stem, contents green, usually with red or reddish-yellow spots.

Propagation by zoospores formed by the simultaneous subdivision of the contents, which pass out and become distributed.

[The curved forms of the older cells enable this genus to be readily recognized. The young cells are short, and often attached. Later they become much curved in half-circles, or s shaped.]

### b. PSEUDOCÆNOBIA.

### 38. Genus *Sciadium* A. Braun.

Family of cylindrical or somewhat curved cells, united by short stems; on the ends of the older cells the daughter-cells stand fan-like, and this arrangement is repeated with the daughter-cells, making a tree-like growth.

Propagation by elongated zoospores, formed by division of the contents, usually into six parts, which escape through the end of the cell, the top being thrown off like a lid. They become attached at the summit of the cell, and there grow, producing the characteristic form of the plant.

[The intimate connection between this genus and *Ophiocytium* will be readily seen. In one case the zoospores separate, in the other they grow together about the end of the mother-cell.]

### c. CÆNOBLE.

### 39. Genus *Scenedesmus* Meyen.

Cells elongate, polymorphous, often with spine-like projections at the ends, joined by their sides in series of 2-8.

Propagation by gonidia formed by division of the contents of a mother-cell. These arrange themselves within the latter in the form of a new cœnobium.

[A very common genus, of considerable interest from its close relation to *Hydrodictyon* in regard to



the process of forming new families within the mother-cells.]

40. Genus *Sorastrum* Kützing.

Cænobium globose, solid within, formed of 4-8-16 or more radially arranged, wedge-shaped, or compressed-cuneate cells, with sinuate or concave margins and bifid at the corners. Propagation unknown.

[This genus resembles *Staurogenia*, and is usually placed near to it in systematic works. Kirchner, however, places this genus here, probably because of the definite character of the cænobium.]

41. Genus *Selenastrum* Reinsch.

Cells semilunate or almost sickle-shaped, joined together at the middle of the convex surfaces, in spherical families of 4-8 cells. Propagation unknown.

[It is by no means certain that this genus is not more closely associated with *Raphidium*, (5,) but the arrangement of the cells in families, although somewhat variable in different species, is rather more definite than in *Raphidium*.]

42. Genus *Cælastrum* Nägeli.

Cænobium spherical, hollow, formed of a single layer of cells, with clear spaces interspersed between them. Cells angular by mutual pressure or spherical.

Macrozoospores form a new cænobium within the mother-cell, which is set free by rupture of the latter.

43. Genus *Pediastrum* Meyen.

Cænobium flat, disk-like, formed of 8-16-32 cells. Cells angular, those in the periphery truncate at the base and dilated outwards, notched in the middle of outer margin.

Propagation by micro- and macrozoospores. Macrozoospores formed by repeated division of one cell of the family. They come out from the mother-cell enclosed in an envelope, within which they arrange themselves, after they have come to rest, into a new cænobium. The microzoospores form in the same way, but in greater number, escape from the mother-cell, and swarm about in the

water; nothing further is known of them, but they probably conduct themselves like those of *Hydrodictyon*.

[*Pediastrum* resembles a round or oval desmid, but it differs in being made up of several distinct cells forming a cænobium.]

44. Genus *Hydrodictyon* Roth.

Cænobium consisting of many large, cylindrical cells, so united by their ends as to form a closed net of numerous polygonal, usually pentagonal meshes.

Propagation by macro- and microzoospores. Macrozoospores pear-shaped, with two cilia in great number within the mother-cell, where they remain for some time in active motion, then join together and form a net like the parent, which escapes by the solution of the cell-walls, and grows to a large size.

Microzoospores form in like manner in great numbers within a mother-cell (as many as 30,000), each with 4 cilia. They escape through a lateral opening, swarm about, and may copulate. After copulation they come to rest, and form spherical cells, resembling *Protococcus*. After a long time, and dessication, their contents produce 2-5 large swarm-cells with 2 cilia, which escape, and after swimming about come to rest. They then grow to large, angular, irregular cells, with points or horns at the angles (*polyedern* Pringsheim), which produce new nets by division of their contents, in the same manner as in the propagation by microzoospores.

[The nets of *Hydrodictyon* may grow to a length of 12 inches or more. They are common in ponds almost everywhere, most abundant in June and July.]

Family III. VOLVOCACEÆ Kirchner.

Vegetative cells during their entire life in motion, by means of cilia. Propagation sexual, or by copulation of swarm-cells, or asexual.

In accordance with present knowledge the family is divided into—

*a.* Genera with only asexual propagation.

*b.* Genera with sexual propagation. In making this convenient division, it should be understood that the distinction is not regarded by the present writer as having the slightest permanent value. It will be observed that as here used the term sexual propagation applies only to propagation by means of male and female cells, the former (antheridia) giving rise to spermatozooids; the latter to oogonia, which are fertilized by the spermatozooids.

It by no means follows that this is the only process of sexual propagation among these algæ. It may be said, and with considerable reason, that the conjugation and fusing together of microgonidia, as in the genus *Chlamydomonas*, for example, is a true sexual process; indeed, we have so designated it in several instances, for want of a better term. Nevertheless, we are rather inclined to regard this process as a sort of parthenogenesis, although there are observations which tend strongly toward a different view.

#### A.—Propagation Asexual.

Families of spherical or tabular form; in some cases the cells of the family separate from each other and each one swims free, like swarm-spores of the confervas.

Propagation by pairing of the swarm-cells, or asexual by parthenogonidia or unsexual swarm-cells. The copulation of the swarm-spores has been certainly observed in two genera, but in some other genera swarm-spores of two kinds, macro- and microgonidia have been seen, which indicate a not yet observed copulation of the micro-gonidia.

#### *Synopsis of Genera.*

Cells single, motile.

Green, centre red, envelope widely extended from plasma.

*Chlamydococcus*, 45.

Green, envelope close.

*Chlamydomonas*, 46.

Cells in motile families.

Family spherical, 8 spindle-shape cells in hyaline sphere.

*Stephanosphaera*, 47.

Family flat or tabular, 4-16 cells in hyaline envelope.

*Gonium*, 48.

Family spherical, cells brownish, wedge-shape, 2-32 in berry-like mass, within hyaline envelope. *Synura*, 49.

Family spherical, cells angular, in berry-like mass, within hyaline envelope.

*Pandorina*, 50.

Genus of doubtful value omitted.

*Spondylomorum*.

45. Genus *Chlamydococcus* A. Braun.

Families do not remain united after their growth from one mother-cell, but the individual cells (macrogonidia) separate. These are spherical, covered with a cellulose membrane, which is commonly somewhat widely separated from the plasma (mantel-like), with green, in the middle red, contents, the anterior end colorless, pointed, with 2 flagella; the plasma-body usually attached to the membrane by gelatinous extensions.

Sexual propagation unknown.

Asexual multiplication of two kinds:—1. By macrogonidia 2-4-8 from a mother-cell, which come to rest and after a period of dryness divide into 2-8 swarm-cells, with 2 flagella. 2. By repeated division of one mother-cell a large number of microgonidia are formed, with 2 cilia, of red or dull green color and with a red spot. These (perhaps after copulation) come to rest.

[The so-called red snow, commonly known as *Protococcus nivalis* or *Hæmatococcus nivalis*, is now placed in this genus as *Chlamydococcus nivalis*.]

46. Genus *Chlamydomonas* Ehrenberg.

Families do not remain united, but the individual cells separate. These (macrogonidia) are similar to those



of *Chlamydococcus*, oval or round, with a closer envelope, entirely green contents, a starch-granule, 2 vacuoles and 2 cilia.

Sexual propagation by copulation of microgonidia, which form in indefinite number in one mother-cell, egg-shape, of greenish or yellow color, with a hyaline end, a red spot, and 2 cilia. These may be distinguished as male and female. The former 8 the latter 2-4 in a mother-cell. In copulation the male cell is wholly absorbed in the female. The zygospore is thus produced and by repeated division, the daughter-cells not being motile, into a *Pleurococcus*-like resting condition.

Asexual multiplication by division of vegetative cells in 2-8 microgonidia with 2-4 cilia, which go into a resting condition.

[*Chlamydomonas* resembles *Chlamydococcus*, but the mature motile cells differ as follows:—In *Chlamydococcus* the envelope stands away from the green contents; in *Chlamydomonas* it is close. *Chlamydococcus* has a red central portion; *Chlamydomonas* has not, but sometimes has a parietal red pigment spot. The former also has well-defined starch-vesicles.]

#### 47. Genus *Stephanosphaera* Cohn.

Family spherical, consisting of 8 spindle-shape cells, regularly arranged in a circle, with green contents and 2 cilia each, enclosed within a hyaline sphere.

Sexual propagation unknown.

Asexual multiplication by division of each vegetative cell into 8 daughter-cells which grow into new families, as in *Eudorina* and *Pandorina* (50.51). Also microgonidia with 4 cilia are produced, which, probably after copulation, become red resting-cells whose contents, after dessication are transformed into 4-8 swarm-cells (macrogonidia) each with two cilia. These in turn give rise to new families.

#### 48. Genus *Gonium* Müller.

Families of 4-16 cells in a single,

tabular quadrangular layer, enclosed by a common gelatinous envelope. Cells somewhat polygonal by mutual pressure, enclosed by a delicate envelope, with green contents, a starch-granule, 2 contractile vacuoles, 2 long flagella and a red spot.

Sexual propagation unknown.

Asexual by repeated division of all vegetative cells forming new families.

#### 49. Genus *Synura* Ehrenberg.

Families spherical, 2-32 wedge-shape cells in grape-like families, of brownish color, without pigment-spot, without firm envelope, with 2 long flagella.

Sexual propagation unknown.

Asexual by breaking up of the families into single cells; these cells continue motile and produce new families by division, or they become resting cells, surround themselves with a gelatinous envelope and multiply by binary division. The growth of new families from these resting cells has not been observed.

#### 50. Genus *Pandorina* Bory.

Families spherical or nearly so, composed of cells aggregated together in grape-like masses, the whole enclosed in ample hyaline envelope. Families of 16, 32 or 64 cells, somewhat angular by mutual pressure, each with 2 flagella, green contents, and usually with a red spot.

Sexual propagation by pairing of similarly shaped swarm-cells of different families. These form by the division of all the cells of one family in (usually) 8 swarm-cells, spherical, green with a red spot and colorless end, with 2 cilia. When set free they copulate with other swarm-cells, joining by their anterior ends, finally fusing together, and form a red zygospore. After a period of rest this gives rise to 1-3 large macrogonidia, each of these becomes quiet and produces a new family by division.

Asexual propagation as in *Eudorina* (51).

#### B.—Copulation Sexual.

Families spherical, moving about

by means of the cilia of the individual cells.

Sexual propagation by oogonia and antheridia. The latter form by the enlargement of single vegetative cells, the contents giving rise to spermatozooids. The oogonia are produced by the enlargement of other vegetative cells. When ripe the oosphere is surrounded only with a gelatinous covering. The spermatozooids penetrate the latter and the fertilized sphere becomes covered with a thick membrane. After a period of rest it germinates.

Asexual multiplication by division of vegetative cells of considerable size (parthenogonidia), giving rise to new families, which separate from the mother-family as soon as the cilia are developed.

### *Synopsis of Genera.*

Families spherical, cells in berry-like mass, within thin hyaline envelope.

#### *Eudorina*, 51.

Family a hollow sphere, with green cells regularly disposed within the surface.

#### *Volvox*, 52.

#### 51. Genus *Eudorina* Ehrenberg.

Families ovate, usually of 16 or 32 cells, within a hyaline, gelatinous envelope; cells spherical, with thin membrane, each with 2 cilia, green, colorless in front, with a starch grain, pigment spot, and 2 pulsating vacuoles in the colorless end. Cells evenly spaced around the outside of the sphere, the cilia projecting as in *Volvox* (52).

Antheridia form in the four anterior cells of the family, the remaining 28 cells producing oogonia. Oospores red, smooth or somewhat stellate.

Asexual propagation by division of vegetative cells into 16-32 daughter-cells, which at first are united into a *gonium*-like, tabular family (48), afterwards becoming spherical.

[*Eudorina* and *Pandorina* are scarcely different enough to make two genera. In the latter the common envelope and the membranes of the

individual cells are rather thicker than in *Eudorina*. The shape of the *Eudorina* family is described as oval, that of *Pandorina* globose or sub-globose, but this character is not of much value, or even constancy. The process of sexual reproduction may serve as a distinction for the time, but it is probable that *Pandorina* also propagates in the same manner. It has been stated that *Eudorina* is dioecious.]

#### 52. Genus *Volvox* Ehrenberg.

Family consisting of many cells, spherical, continually rotating, resembling a hollow globe with green cells regularly disposed just within the surface, each with 2 long cilia projecting through the common, hyaline envelope, a red spot, and two pulsating vacuoles.

Sexual propagation by biciliated spermatozooids formed within special cells, and oogonia, forming red oospores.

Asexual propagation forming new families within the parent sphere, by division of certain cells. These are set free by the rupture of the parent sphere.

[*Volvox* may well be regarded as the highest type of this interesting family. There are two species generally recognized which are distinguished by their difference in size, *V. globator* and *V. minor*. The former is dioecious, the latter monoecious.]

[To be continued.]

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### Germicides and Antiseptics.

In a lecture before the Biological Society of Washington some time ago Dr. Geo. M. Sternberg, U. S. A., gave the following lists of germicides and antiseptics. A germicide is an agent which destroys the life of an organism. It may be able to kill only the actively growing organism, or it may also kill the spores. Antiseptics may not be germicides. They may only prevent the growth of organisms without killing them.



Germicides which kill micrococci and bacilli.

Heat—five minutes boiling at  $212^{\circ}$  F

Mercuric chloride . . . . . 1–10,000

Sulphuric acid . . . . . 1– 100

Sulphuric dioxide . . . . . 1– 100

Carbolic acid . . . . . 1– 50

Antiseptics which are not germicides. (Prevent growth but do not kill the organisms).

Sulphate of copper 15% solution failed.

Sulphate of iron saturated “ “

Sulphite of soda “ “ “

Sulphite of zinc “ “ “

Sulphate of zinc “ “ “

Sulphite of lime 50% “ “

Alcohol 95% “ failed

to kill in 48 hours.

Germicides which destroy spores.

Dry heat,  $130^{\circ}$  C.

Moist heat,  $105^{\circ}$  C. ( $221^{\circ}$  F.) five minutes.

Mercuric chloride . . . . . 1–1,000

Liquor sodæ chlorinatæ . . . . . 10%

Liquor zinci chloridi . . . . . 10%

Sulphuric acid . . . . . 8%

Nitric acid . . . . . 8%

Muriatic acid . . . . . 15%

It is a remarkable fact that sulphurous acid, upon which so much reliance is placed for disinfecting, does not destroy spores. Even the pure liquid sulphurous acid does not kill the spores of anthrax. Pieces of cotton dipped in culture-fluids were placed in bales of rags to be disinfected by sulphurous acid, which was forced into them. The experiment failed to kill the spores.

—o—

### Discrimination of Butter and its Substitutes.

Dr. Thomas Taylor, Microscopist of the Department of Agriculture, at a meeting of the Washington Microscopical Society, held on the evening of May 26th, read a paper on some discoveries he has recently made while experimenting with butters and the various forms of butterine and oleomargarine. He first boiled a number of samples of pure butter obtained from Maryland, New York, Ohio,

and other States, for the purpose of crystallizing their fatty acids. After a lapse of twenty-four hours, during which time they were laid away in a cool place to crystallize, on placing small portions of each under the microscope, using cotton-seed oil as a mounting medium, he discovered that the crystals of pure butter were sometimes globular and sometimes ellipsoidal in shape, and on turning the polarizer so as to cross the analyzer there appeared on each a well-defined cross, having equal arms, like that known as the St. Andrew's cross, and that on rotation of the polarizer the cross rotated in like manner. He found also that the crystals of butterine and of oleomargarine, beef and swine fats, are of stellar form, and differ from each other. These do not exhibit the cross spoken of in the case of true butter, and do not follow the rotation of the polarizer. In this way butters may be distinguished from oleomargarine made of beef or swine fats.

Dr. Taylor stated that only in fresh butter has he been able to detect the cross in perfect form, and that in butter which has been kept for some time, or butter of inferior quality, when boiled and viewed under the polarizer, the crystals present a rosette form, generally four-lobed, and these rotate on the turning of the polarizer as do those in fresh butter—conditions not observed in any other fatty bodies, animal or vegetable.

—o—

### Eye-Piece Micrometers.

For some months past, my friend, Dr. M. D. Ewell, and myself have been working at micrometry, and the relative advantages of the eye-piece and cobweb micrometers. A short time ago we decided to make a series of independent measurements to see which method was superior. Two slides of fresh blood were prepared under the same circumstances, as nearly as possible, the blood was

dried about half an hour in the air of a well-warmed room, and then sealed in a cell, so that the degree of dessication would be the same, and the measurements were made the same evening, independently. The doctor used a  $\frac{1}{10}$  Spencer (homogeneous immersion, N. A. 1.35) with an amplifier and 1-inch eye-piece, giving a power of about 2000, and I a  $\frac{1}{10}$  Spencer (homogeneous immersion, N. A. 1.25) with a  $\frac{3}{4}$ -inch eye-piece, power 1562. He measured twenty-five corpuscles, the average being  $\frac{3}{3138}$ -inch and I measured fifty with an average of  $\frac{3}{3139}$ -inch, the difference between our measurements being only  $\frac{1}{986000}$ , an amount far too little to measure, this being only the finale of a considerable amount of similar experiment in the same direction: I feel pretty well convinced that the cobweb micrometer does not offer sufficient advantage in point of accuracy to compensate for its additional cumbersomeness and expensiveness.

HENRY L. TOLMAN.

CHICAGO, Ill.

## EDITORIAL.

**Publisher's Notices.**—All communications, remittances, exchanges, etc., should be addressed to the Editor, P. O. Box 630, Washington, D. C.

Remittances should be made by postal notes, money orders, or by money sent in registered letters. Drafts should be made payable in Washington, New York, Boston, or Philadelphia.

Subscription-price before April 1st, \$1 per year, in advance. All subscriptions begin with the January number. After April 1st the subscription-price will be \$1.50.

The regular receipt of the JOURNAL, which is issued on the 15th of each month, will be an acknowledgment of payment.

The first volume, 1880, is entirely out of print. The succeeding volumes will be sent by the publisher for the prices given below, which are net.

Vol. II (1881) complete, \$1.50.

Vol. III (1882) complete, \$2.00.

Vol. IV (1883) complete, \$1.50.

Vol. V (1884) complete, \$1.50.

Vol. V (1884), Nos. 2-12, \$1.00.

**SOME CITY SANITATION.**—We do not know that the majority of our readers are especially interested in sanitary matters which do not immediately concern them, but they will, at least, be surprised, and perhaps amused, at the vast influence

the microbes of disease have come to exert in the legislation of the city of New York. The following quotation from the *New York Herald* will explain itself. It seems that the public welfare demands that the numerous telephone and telegraph wires in the city should be placed under ground. As this is a matter of considerable expense, the companies prefer not to comply with the regulation. The Board of Health and certain eminent physicians who should (and probably do) know better, have thus conspired to defeat the plan of underground wires:—

'The Board yesterday received from Drs. Fordyce Barker, Alfred L. Loomis and H. B. Sands the following letter:—

'Our attention has been called to the proposed action of the various telegraph, telephone, messenger and electric companies for placing wires under ground during the ensuing season, in compliance with the provisions of a law passed at the last session of the Legislature, which made it compulsory that all electric wires in the city of New York should be placed under ground by the 1st of November next.

'In this connection we are very much impressed with the bearing which this proposed action may have upon the public health of this city, as a simultaneous tearing up of the various streets and avenues for the purpose of complying with the provisions of the above law will, in our opinion, be very detrimental to the health of the city, inasmuch as the underlying structure of our streets is composed of material more or less saturated with coal gas and other noxious gases, which, when let loose, will contribute to the unhealthfulness of the city.

'We are more apprehensive on this subject just at the present season than possibly at any other time, for the reason that we may not unreasonably expect to have a visitation of cholera here during the summer months, and the above result would certainly tend to make the sanitary condition of the city more difficult to perfect.' . . .

'The Health Commissioners, after the reading of the letter, adopted the following preamble and resolutions:—

'Whereas the attention of this Board has been called by several eminent physicians to the danger to the health of the city likely to result from the general open-



ing of the streets and avenues during the coming season for the purpose of putting under ground the numerous telegraph wires, as required by a recent act of the Legislature.

*Resolved,* That in the opinion of this department, while the occasional opening of a street or avenue in ordinary times for the laying of a water or gas pipe or for other similar purposes might not seriously threaten the health of the city, the execution of so extensive a piece of work as the laying of all telegraph wires under ground in one season, as contemplated by the act referred to, or to make extensive excavations in the streets for any purpose, would prove highly detrimental to the health of the city, especially in that portion densely populated, through the exposure to the atmosphere of so much subsoil saturated, as most of it is, with noxious gases, and that it would be wise for all parties, officials and others, to avoid as far as possible during the approaching summer making any street excavations not imperatively needed by the exigencies of the public service.

Probably nobody dreams that all that cut-and-dried preamble and resolutions of the Board of Health were purely in the interest of public health. But can it be possible that Dr. Fordyce Barker, for example, really believes that the tearing up of the New York streets would be followed by, or in any wise contribute to, such dire consequences? If not, why did he or his associates concoct such a communication? Either it must have been through ignorance, or else self-interest. In either case it was reprehensible in such men.

It is not, perhaps, within our province to make notice in these columns of such matters, yet from one point of view it seems to be so, for it is the duty of every editor of a scientific publication to condemn without fear or favor whatever, in the guise of science, may seem calculated to deceive, and especially when it emanates from those whose high position gives great, or undue, weight to their utterances. It is thus that the scientific press can exert an influence, which will counteract the tendency now and then manifested among able

men of science to sacrifice their integrity for the sake of gain. Thus it would come to pass that a man's reputation would depend not, as it too often does, upon public favor, but upon the more critical estimate of his associates and co-laborers.

—O—

POSTAL CLUB BOXES.—Box B<sup>2</sup> came to hand April 14th, containing some excellent preparations from Troy, N. Y., all well described.

1. Leaf of sundew, *Drosera rotundifolia*. R. H. Ward. The glandular trichomes of the leaf which secrete a viscid fluid to capture insects and digest them to supply food for the plant are well shown.

2. Cancer, Scirrhus carcinoma. J. D. Lomax.

3. Transverse section of tongue of cat. C. E. Hanaman. An exceedingly good and interesting section, well described in the letter.

4. Internal parasite of black bass. Frank Ritchie. The name is not given by the preparer, but A. S. Packard writes that it is probably an *Echinorhynchus*. Mr. Ritchie suggests that it was probably introduced into the lakes about Troy from Rochester, from whence the lakes were stocked, as the parasites had not been observed previous to time of stocking.

5. Urns or spore-capsules of a moss, *Funaria hygrometrica*. Joseph McKay. Mounted dry in a brass cell with a lid. A fine preparation for study. The preparer offers duplicates, mounted with glass covers, for exchange. His address is Troy, N. Y.

6. Ossifying cartilage. A. M. Wright. An excellent preparation for study.

Box Y<sup>2</sup> came to hand April 18th with the following preparations:—

1. Section of stomach of hound. H. B. Chamberlin.

2. Crystallized native silver. Prof. L. D. Short. Somebody asks, 'Where from?'

3. Transverse section of a human tooth, with ossified pulp. Dr. A. B. Robbins. A good section.

4. Section of kidney of jack rabbit. Geo. C. Faville.

5. Section of petrified cedar wood. H. F. Wegener.

6. Section of kidney of kitten. A. W. Chamberlin.

Some of these preparations are very poor, and we trust the preparers will send in more creditable work next time. A little more care and neatness in mounting as well as in preparing the specimens is desirable.

Box Cz, containing two of Cole's preparations, came to hand April 24th. The subjects are sections of human cerebrum and cerebellum.

Box G came to hand May 24th with six excellent preparations.

1. Ureter of hog. Dr. W. H. Currier, showing fibrous outer coat and inner mucous coat with epithelium.

2. *Utricularia*. Henry M. Brown. A fine preparation by Mr. L. R. Peet, of Baltimore, who was one of the most expert preparers of stained vegetable specimens. The colors in this preparation are still excellent. This plant is said to catch and kill young fishes.\*

3. Section of small intestine of cat. Rev. E. C. Bolles.

4. *Caprella geometrica*. Rev. J. D. King. A fine preparation. 'The slide was mounted some years ago, before anything was said about mounting without pressure.' It is a balsam mount of first-class character.

5. Transverse section of petiole of *Brasenia peltata*. N. N. Mason. Two very excellent, well-stained sections. The starch in the cells shows beautifully with the polariscope.

6. Spores and elaters. Miss M. A. Booth. An interesting preparation, showing well the structure of the elaters.

—o—

#### SILVERING GLASS REFLECTORS.—

We promised long ago to give a process for silvering mirrors in these columns, but hitherto we have not been able to refer to some notes of

experiments, which we desired to use in writing up the subject.

There being no immediate prospect of finding them, we now give a formula, which is practically the same as we have successfully used. It is the same as Mr. John Browning recommends for silvering glass specula for telescopes.

The glass must first be thoroughly cleaned. Plunge it into nitric acid, and in a few moments wash thoroughly in clean water. Then polish it with putty-powder. It is then ready to receive the coating of silver.

Make three solutions composed as follows:—

A. Silver nitrate.....45 grains.

Water.....2 ounces.

B. Caustic potassa (by alcohol)..... $\frac{1}{2}$  ounce.

Water.....12 ounces.

C. Milk sugar..... $\frac{1}{2}$  ounce.

Water.....5 ounces.

Take one ounce of solution A and add solution of ammonia to it drop by drop, with constant stirring, until the dark-brown precipitate at first thrown down is dissolved in a slight excess of ammonia. Add now to this 2 ounces of solution B. This will produce a precipitate, which must be redissolved as before by the careful addition of ammonia. Now make up the bulk of the solution to 8 ounces by the addition of water, and in order to neutralize any excess of ammonia that may be present add a few drops of solution A, until a slight precipitate thus formed does not redissolve. Then add 7 ounces of water. Set the solution aside to settle, and then pour off the clear fluid.

When ready to silver the cleaned glass, mix a sufficient quantity of the solution as prepared above with one-fifteenth its volume of solution C, (15 oz. to 1 oz.), and pour the mixture into a shallow dish in which the glass to be silvered is supported, face down. The silver will then be slowly deposited upon it, the rapidity varying with the temperature. It may



require an hour or more to complete the operation, but in warm weather an hour will usually suffice.

When the deposit is thick enough it may be protected by a coat of photographers' varnish. The silvered surface may also be polished if desired, using fine wash-leather and rouge—but for glass mirrors this is not necessary as the deposit seen through the glass is bright.

The solution of silver will keep, but after mixing with solution C it rapidly decomposes, the silver being thrown down in the metallic state.

### NOTES.

—A women's anthropological society, the first of the kind in this country, has just been organized in Washington. The first meeting was held June 8th, Mrs. Col. James Stevenson presiding and Miss S. A. Scull acting as secretary. Officers for the year were elected as follows: President, Mrs. Col. James Stevenson; recording secretary, Mrs. Romyn Hitchcock; corresponding secretary, Miss S. A. Scull; treasurer, Mrs. John W. Foster. Miss Cleveland, who was mentioned as the first mistress of the White House who had manifested an active interest in scientific pursuits, was requested to name the society, and did so. There is good talent among the cultured ladies in Washington to conduct such a society in a creditable manner, and we shall hope to see an instructive and valuable volume of Proceedings emanating from it at an early day.

—The announcement of the next meeting of the American Society of Microscopists has just been issued.

The eighth annual meeting of the society will be held at Cleveland, Ohio, beginning on Tuesday, August 18th, 1885, lasting four days. Members of the society will need little urging to attend, for the steadily growing interest in the meetings for seven years is a sufficient guaranty that they will look forward to this one with eager anticipation.

Titles and abstracts of papers should be sent as soon as practicable to the secretary, Prof. D. S. Kellicott, Ph. D., 119 14th street, Buffalo, N. Y.; and all who intend to be present or to join the society are requested to notify him or the local committee at Cleveland, Ohio.

The session for illustration of practical work in preparing and mounting objects will be still more varied and instructive than heretofore. Mr. C. M. Vorce, of Cleveland, has charge of the preparations for the working session.

—Dr. R. H. Ward has written a systematic treatise on the microscope of the present day as compared with the past, which covers twenty-four large octavo pages in Appleton's Cyclopaedia. The article is already printed and will soon be issued in the forthcoming volume. It is fortunate that the publishers entrusted the work to Dr. Ward, who is undoubtedly more competent than any other person in the country to treat the subject.

—The great Bartholdi statue, the largest in the world, which is to stand in the harbor of New York, will doubtless be landed by the time these lines are printed. An illustration of the statue is given this month in our advertising columns, and the committee having the matter in charge are offering statuettes to all subscribers toward the completion of the pedestal. The London *Daily News*, in speaking of it says: 'It is out and away the largest statue of modern times. The Colossus of Rhodes was nothing to it. It could carry the "Bravaria" or the "Hermann" in its arms. It towers to the skies from the yard of the Rue de Chazelles, where it has been eight years in construction, and the view from its coronet sweeps clear of the six-story houses and beyond the walls of Paris.'

—Absolute alcohol, or what for all practical purposes may be regarded as absolute alcohol, is prepared in Ranvier's laboratory by removing the water from 95% alcohol by means of anhydrous cupric sulphate. Ordinary blue vitriol is pulverized and heated to redness in a crucible. The white powder thus obtained is added to 95% alcohol, and allowed to stand a day or two with occasional shaking. The powder takes up the water that is in the alcohol, turning blue as it does so. The alcohol is then poured off, and the operation repeated if necessary, which will only be the case when the copper salt is almost entirely changed to blue.

### CORRESPONDENCE.

TO THE EDITOR:—I see in an editorial note which follows my article on the gum of liquidambar styraciflua you state that it can be obtained at any drug-store. Is

not this an oversight? I have been unable to procure it in drug-stores. Messrs. Eimer & Amend, after much trouble, sent me a small sample, perhaps half an ounce, which had been taken from a private collection of drugs. Druggists down South even rarely have it. That used by European mounters usually comes from Central or South America, and can only be obtained from one or two firms. The styrax or storax of the shops is the gum of *L. orientale* (more or less pure). It is much darker, more sticky, and has a far stronger odor, at times nearly sickening. I much prefer the American gum, and have entirely discarded the ordinary styrax of the drug stores. I think upon examination you will find that I am correct.

I am glad to see that you are publishing a translation of the article on staining from the *Zeitschrift f. Wissen s. Mikroskopie*; the original is certainly excellent. Your readers generally should be pleased.

A. B. AUBERT.

## NOTICES OF BOOKS.

*Micro-Chemistry of Poisons*, including their Physiological, Pathological, and Legal Relations; with an Appendix on the Detection and Microscopic Discrimination of Blood: Adapted to the use of the Medical Jurist, Physician, and General Chemist. By Theodore G. Wormley, M. D., Ph. D., LL.D., Professor of Chemistry and Toxicology in the Medical Department of the University of Pennsylvania. With ninety-six illustrations upon steel. Second edition. Philadelphia: J. B. Lippincott Company. 1885. (Large 8vo, pp. 741 and 17 plates. Price: Cloth, \$7.50; sheep, \$8.50.)

This work is not merely a treatise on the detection of poisons with the microscope, but a complete manual of toxicology for the physician and chemist. The microscopical characters of the crystals of such compounds as are in any wise characteristic are described, and beautifully delineated by Mrs. Wormley, who has made all the engravings on steel. The quantities of poisons that can be recognized are in some cases truly microscopic. For instance, 1-10000 of a grain of arsenic, mercury, strychnine, or hydrocyanic acid can be recognized with absolute certainty—indeed, 1-100000 of a grain of hydrocyanic acid will give a characteristic crystalline compound.

Perhaps we can do no better than to quote a few paragraphs from the book to show the concise and clear style of the writer, who, it need scarcely be said, has no superior in toxicology. For this purpose we will choose the reaction of mercuric chloride with nicotine, as this is a test which can readily be repeated by the reader. The reactions are carried out in watch-glasses.

1.  $\frac{1}{100}$  grain of nicotine in one grain of water yields a copious white precipitate, which in a little time becomes yellow, and yields a mass of large groups of crystals. These crystals are especially beautiful under polarized light.

2.  $\frac{1}{500}$  grain: yields a rather copious, dirty-white precipitate, which soon deposits colorless crystals.

3.  $\frac{1}{1000}$  grain: in a few seconds the mixture becomes turbid, and soon there is a quite good, white, flocculent precipitate, which afterwards yields crystals having the same forms as illustrated above. If, upon the addition of the reagent, the mixture be stirred with a glass rod, it immediately yields streaks on the bottom of the watch-glass over the path of the rod.

The Appendix treats of blood, its composition, detection, and discrimination. Some of the measurements of the corpuscles are quoted on another page. The conclusion as regards the possibility of microscopical discrimination is given in these words:—'The microscope may enable us to determine with great certainty that a blood is not that of a certain animal and is consistent with the blood of man; but in no instance does it, in itself, enable us to say that the blood is really human, or indicate from what particular species of animal it was derived.'

The book is invaluable to all who are interested in the applications of the microscope in chemistry and toxicology.

## Exchanges.

[Exchanges are inserted in this column without charge. They will be strictly limited to mounted objects, and material for mounting.]

Seeds of *Orthocarpus purpureus*, in exchange for other objects, mounted or unmounted.

EDWARD GRAY, M. D.,  
Benicia, California.

Diatomaceous earth from Denver, Colorado, in exchange for mounting material.

H. B. CHAMBERLIN,  
280 Fifteenth St., Denver, Colorado.



# THE AMERICAN MONTHLY MICROSCOPICAL JOURNAL.

VOL. VI.

WASHINGTON, D. C., JULY, 1885.

No. 7.

## Opercularia Constricta, n. sp.

BY D. S. KELLICOTT.

In November last, I found, among some *Utricularia vulgaris* and *Chara coronata* collected from a ditch filled with rather pure water, an aquatic, lepidopterous larva. It inhabited a free case similar to that of a phryganeid larva, and constructed, likewise, of silk holding together fragments of *Lemna*, etc.; probably it is the preparatory stage of a species of *Cataclysta*. On nearly all the caterpillars examined there occurred an interesting, commensal vorticellid abounding on the sides of the thoracic rings. I have said that it is an interesting form, a remark which it is safe to make concerning any infusorian, but this one, an opercularian, is especially interesting, both from the fact of its commensalism on a case-bearing larva, and from certain striking individual characteristics, which indicate that it is specifically distinct, and which render it easy of recognition. In allusion to one of its distinctive features it may aptly, properly be called *Opercularia constricta*.

The body is elongate, somewhat fusiform, and twice constricted below the peristome, plastic, the cuticular surface smooth, except the attenuate posterior fourth, which is longitudinally striate. On contraction the zooid becomes pyriform, when the striated portion is transversely wrin-



FIG. 10. — *Opercularia constricta*.

kled. The endoplasm contains many coarse granules.

The ciliary disc is comparatively wide and dome-like; its margin is cord-like, with a double row of cilia, one above and one below the marginal ring. The membranous collar is elevated considerably above the border of the peristome. The capacious vestibulum extends first backward and is then bent downwards. The contractile vacuole is situated at the angle of the œsophagus, opposite or just below the second or lower constriction of the body.

The pedicel is short, more or less bent, and bears few zooids—two or four are usual numbers.

Length of zooid  $\frac{1}{100}$  of an inch; width about one-third the length. On aquatic, case-bearing, lepidopterous larva, Squaw Island, Niagara river.

## Notices of New Fresh-Water Infusoria.—III.

BY DR. ALFRED C. STOKES.

*Actinomonas vernalis*, sp. nov. (Fig. 1.)

Body subspherical, the frontal border slightly emarginate, somewhat changeable in shape, free-swimming or temporarily attached by a short pedicel; flagellum entirely vibratile, equalling or somewhat exceeding the diameter of the body in length; endoplasm transparent, slightly granular; pseudopodia few in number, radiating from any part of the periphery, simple or variously branched, often capitate, sometimes curved, their length exceeding the diameter of the body; contractile vesicles sev-

eral, small, distributed near the periphery; nucleus spherical, subcentral. Diameter of body  $\frac{1}{1800}$  to  $\frac{1}{1600}$

the water when in the field of the microscope. On these active germs the actinomonas was so greedily feeding

that its endoplasm was usually crowded and colored by them. In this matter of taking food it has decidedly the advantage of its relatives higher in the scale of life, since the act can be performed in either the sedentary or the freely motile conditions. In the former the pseudopodia are entirely withdrawn, and food is then engulfed at any point on the surface, being taken with a large drop of water, as is commonly done by so many of the mouthless forms.

The movements in the rayless state are comparatively slow and irregular

lar, consisting of a revolution on the longitudinal axis, with sudden changes of position, and with a frequent, rapid, but not long continued trembling or shivering of the entire body, very little space being traversed by its efforts, the motions not being those of the gigantic monas which the infusorian then closely resembles. When in this monadiform condition it is

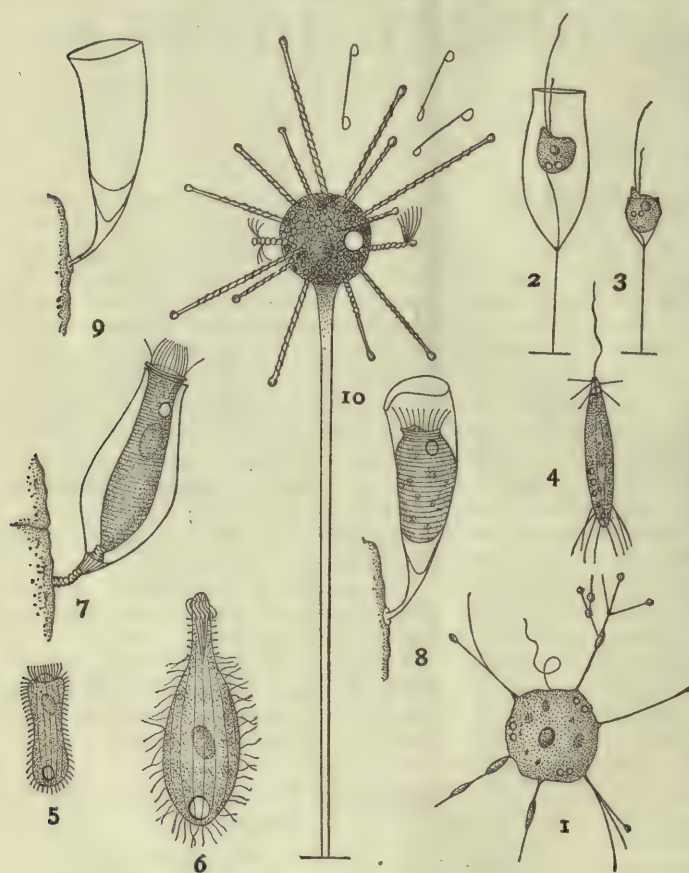


FIG. 20.—New Fresh-Water Infusoria.

inch. Habitat.—Shallow ponds in early spring.

This remarkable combination of rhizopod and infusorian was abundant in the first gathering made in early spring from a shallow little pool near a country wayside. Green algæ were already a conspicuous feature of the surface, and their flagellate spores quite as conspicuous constituents of

#### EXPLANATION OF FIGURES.

Fig. 1. *Actinomonas vernalis*  $\times 750$ .

Fig. 2. *Bicosaca dissimilis*  $\times 720$ .

Fig. 3. *B. acuminata*  $\times 720$ .

Fig. 4. *Mallomonas litomesum*  $\times 750$ .

Fig. 5. *Lacrymaria vertens*  $\times 180$ .

Fig. 6. *Lagynus lasius*  $\times 312$ .

Fig. 7. *Cothurnia plectostyla*  $\times 275$ .

Fig. 8. *Cothurnia bipartita*  $\times 225$ .

Fig. 9. *Cothurnia bipartita*. Variety with elliptical aperture

Fig. 10. *Podophrya macrostyla*  $\times 250$ .



easily recognized as a member of the genus *actinomonas* by this peculiar and characteristic shivering. When quietly seated at the extremity of the short temporarily developed pedicel, the flagellum dashes the food-particles into contact with the pseudopodia, which then draw it into the body, a performance characteristic of the genus.

The pseudopodia themselves are usually simple and often tipped by a minute spherule of protoplasm, with one or more protoplasmic enlargements in the course of the ray, and a frequent thickening at any point by a flow of sarcode, after the manner of the rhizopoda. The branching, in the individuals observed, was at times a simple bifurcation, occasionally becoming compound as shown in the figure.

The small contractile vesicles are scattered near the periphery, their exact number being difficult to determine on account of their irregular distribution and apparently different distances from the surface under examination. At least six can be detected, two placed near the frontal border, two on the opposite side near the equator, and two in the posterior part of the body. This large number would be sufficient to distinguish the creature from the previously observed species, all of which are marine, did not the branching pseudopodia serve the purpose better, as this habit has not been noticed in the salt-water forms.

The thread-like pedicel seems to be but seldom protruded unless, in the instances in which I have failed to observe it, the infusorian has been in such a position that the body has obscured it. Two or more of the pseudopodia appear to serve as anchoring attachments, the capitate tips being applied to an algal or other filament. This habit has also been noticed in *A. pusilla*, S. K.

As the infusorian was first obtained in early spring, or what by courtesy toward our abominable winter cli-

mate is so styled, the fact suggested the specific name.

*Bicosæca dissimilis*, sp. nov. (Fig. 2.)

Lorica elongate-ovate, two and one-half times as long as broad, slightly narrowed anteriorly and there forming an inconspicuous, neck-like prolongation, the border truncate, not everted; supported posteriorly on a pedicel nearly equalling it in height; enclosed body subspherical, situated near the centre of the lorica, not in contact with the walls when extended, nor projecting beyond the frontal border; contractile ligament about one-half as long as the lorica; nucleus spherical, subcentral; contractile vesicle double, postero-terminal. Length of lorica,  $\frac{1}{100}$  inch; diameter of enclosed animalcule,  $\frac{1}{3400}$  inch. Habitat.—On *Utricularia* from the pine barrens of New Jersey. Solitary.

There is a remarkable disparity between the size of the infusorian's body and that of the sheath formed for its protection. It is a pigmy in a giant's castle, and it seems a timid creature. Safely surrounded by its transparent walls, it remains near the centre of the single apartment even when the retractile ligament has extended to its greatest length, never passing the anterior opening, never exposing itself to any current except that made by the lashing of its own flagella, the body freely floating at the extremity of the restraining thread. The lip is short and inconspicuous, and the frontal excavation shallow. The long flagellum is very long, and seems to vibrate throughout its entire length. It at least does not present the aspect of a lash curved and vibrating at the distal extremity only, as in most of the forms hitherto discovered. The lorica also is the largest yet noted in any member of the genus, while the enclosed zooid is among the smallest.

*Bicosæca acuminata*, sp. nov. (Fig. 3.)

Lorica irregularly ovate, less than twice as long as broad, slightly nar-

rowed anteriorly, the border truncate, the posterior two-thirds rapidly tapering to a pedicel, two to three times its height; enclosed animalcule subspherical, filling the anterior part of the lorica and projecting beyond the anterior border; contractile vesicle double, the two placed side by side near the centre of one lateral border; nucleus subcentral. Length of lorica,  $\frac{1}{3000}$  inch; of enclosed zooid,  $\frac{1}{4600}$  inch. Habitat.—On *Utricularia* from the New Jersey pine barrens. Solitary or scattered. Reproduction by transverse fission.

This minute form seems as bold as the preceding is timid, sitting at the aperture of the lorica and exposing a considerable part of the body almost continuously, the contractile ligament rarely drawing it to the rear of the sheath. It is also noteworthy in respect to the position of the contractile vesicles, these being usually posteriorly located, often postero-terminal. Reproduction is accomplished quite rapidly, the body elongating and dividing transversely, having previously extended one, probably two, additional flagella. The newly-formed long flagellum is very apparent, the smaller being so excessively minute that its existence could not be positively determined.

The lorica is very delicate. It will not even for a short time resist the action of a solution of caustic potassa, which was applied for the destruction of the enclosed zooid so that the exact form of the sheath could be seen, but which dissolved the lorica almost as soon as the softer body within. This is somewhat unusual, the loricae commonly withstanding even prolonged exposure to the caustic solution.

*Mallomonas litomesum*, sp. nov. (Fig. 4.)

Body elongate-ovate, three times as long as broad, widest centrally, the anterior extremity narrowest, the cuticular surface finely crenulate; the non-vibratile setose hairs confined to the two extremities, the central part of the cuticular surface entirely naked,

those of the posterior extremity longest and most numerous, those about the anterior apex radiating in an almost horizontal direction; flagellum long, slender; endoplasm yellow; contractile vesicles multiple, confined to the posterior body-half; nucleus not observed. Length of body  $\frac{1}{1000}$  inch. Habitat.—Marsh water, with *Sphagnum*.

This pretty creature is remarkable for the naked condition of the central portion of the body surface, a characteristic readily differentiating it from the other members of its genus hitherto described. This species recalls, in this respect the Holotrichous *Cyclidium litomesum* described by the writer in the *American Monthly Microscopical Journal*, December 1884, in which a similar arrangement of setose cilia obtains, the central cuticular surface there also being quite naked. This condition will necessitate a slight change in the diagnosis of the family and generic groups as now formulated.

The endoplasm is lemon yellow in color, the pigmentary matter appearing to be collected in two somewhat indistinct lateral bands, the intervening pale, almost colorless, strip of sarcode filled with fine granular matter, near the centre of which is located what seems to be the nucleus, the latter, however, being very obscure. The oral aperture and the continuation as a narrow pharyngeal passage are usually distinct, the former quite conspicuously so.

*Lacrymária vértens*, sp. nov. (Fig. 5.)

Body subcylindrical, soft, flexible, and somewhat extensile, about three times as long as broad, longitudinally striate; constricted near the middle, the lateral borders consequently concave; cilia fine and numerous; apical extremity rounded, oral cilia numerous; contractile vesicle single, spherical, postero-terminal; nucleus ovate, conspicuous, located in the anterior body-half; endoplasm usually coarsely granular. Length of



body,  $\frac{1}{300}$  inch. Habitat.—Stagnant pond water.

This readily recognized form is only the second fresh-water species hitherto observed, the first being *L. truncata*, which was obtained by the writer in a habitat similar to that of *L. vértens*. The body is very flexible, insinuating itself with ease among and between tangled threads of fungi and heaps of debris. The anterior extremity seems to be the most extensile portion, the region also retracting itself until the smooth apical hemisphere, which is pierced centrally by the oral aperture, is apparently sunken and surrounded by a deep circumvallation, the characteristic constriction of the body then being lost by the dilation of the part. The movements are by rapid revolutions on the longitudinal axis.

*Lagynus lasius*, sp. nov. (Fig. 6.)

Body normally flask-shaped, about three times as long as wide, longitudinally furrowed, the ventral surface flattened; contractile to an ovate form and extensile until elongate-clavate or subcylindrical; anterior extremity rounded, oral aperture terminal; oral cilia conspicuous, those of the general surface long, numerous, vibrating somewhat irregularly and independently, and confined chiefly to the body back of the anterior neck-like prolongation, the latter being rather sparingly ciliate and bearing numerous, immotile, hispid setæ, a series also continued down the dorsal surface to near the posterior extremity; pharynx conspicuous, longitudinally plicate; nucleus subcentral; contractile vesicle single, postero-terminal. Length of body  $\frac{1}{100}$  inch. Habitat.—Fresh water.

A noteworthy feature of this little bottle-shaped creature is that the neck is abundantly clothed with short, stiff bristles with a great decrease in the number of the vibratile cilia, which in equal abundance are borne on the remaining body surface. At first glance the appearance of this roughened neck is such as to lead the observer to

at once imagine that the infusorian has recently taken part in a fierce battle, and has had the anterior cilia broken or in some way incompletely removed; but the perfect condition of the oral circle, and the continuation of a row of the setæ down the median line of the dorsum show that the condition is normal and the infusorian uninjured.

The movements vary with its form. When flask-shaped progression is evenly forward on the flattened ventral surface; when contracted to the broad egg-shape, or extended to the subcylindrical form, it rotates on its long diameter.

*Cothurnia plectostyla*, sp. nov. (Fig. 7.)

Lorica elongate-urceolate, two and one-half times as long as broad, hyaline, slightly compressed, inflated, and somewhat gibbous subcentrally, thence tapering posteriorly to the pedicel and anteriorly to a short, subcylindrical neck, the margin truncate, not everted; pedicel conspicuous, transversely plicate, often sinuose, continued through and filling the tapering posterior extremity of the lorica, and prolonged as a short internal footstalk which is entirely invaginated by the posterior extremity of the contracted animalcule; enclosed zooid transversely striate, when extended projecting very slightly beyond the orifice of the lorica; nucleus broadly ovate, conspicuous, subcentral. Length of lorica  $\frac{1}{100}$  inch. Habitat.—Fresh water, on *Canthocamptus minutus*.

This was very abundant on the entomostracan mentioned, as were what were supposed to be the immature pedicellate zooids which were still without a trace of a lorica. The pedicel of these was long, tortuous, and conspicuously plicate, the ovoid bodies also exhibiting transverse striations. The mature forms are readily distinguished from allied species not only by the shape of the lorica and the very short distance to which the body extends beyond the sheath, but

chiefly by the peculiar wrinkling of the pedicel and its internal continuation, both the zooid and the lorica appearing to be pedicellate.

*Cothurnia bipartita*, sp. nov.  
(Figs. 8 and 9.)

Lorica elongate-subcylindrical or elongate-campanulate, gibbous, somewhat curved, one side being longer than the other; two and one-half times as long as broad, widest anteriorly or at the frontal border, tapering posteriorly, finely striate longitudinally, and with irregular transverse markings resembling lines of growth; transparent, colorless when young; margin not everted; aperture variable in form, either elliptical and the borders even, or narrowly ovate and prolonged for some distance down the shorter side of the lorica, the borders then somewhat unevenly curved; lorica divided posteriorly into two unequal parts by a curved, transverse chitinous partition to which the enclosed animalcule is sessilely attached; pedicel stout, usually curved, widest at its attachment to the sheath, about one-fifth as long as the lorica; animalcule taking the form of the sheath posteriorly, transversely striate, when extended not reaching to the anterior aperture; peristome narrow, everted, not revolute; ciliary disc small, obliquely elevated; nucleus short, band-like, curved. Length of lorica  $\frac{1}{3}\frac{1}{5}$  inch. Habitat.—On *Canthocamptus minutus* from marsh water, with *Sphagnum*.

The longitudinal striations of the lorica are very fine, the irregular transverse lines being much more conspicuous. The former are peculiar to this species, not having been observed in any other member of the genus. They are purposely omitted from the figures. The internal partition, as well as the entire lorica, changes in color with age.

*Podophrya macrostyla*, sp. nov.  
(Fig. 10.)

Body subspherical; tentacles irregularly distributed over the entire sur-

face, distinctly capitate; pedicel seven to eight times as long as the diameter of the zooid, large, hollow, widest at the point of attachment to the body; contractile vesicle single, laterally located; nucleus ovate, subcentrally placed; endoplasm usually coarsely granular. Diameter of the body  $\frac{1}{4}\frac{1}{10}$  to  $\frac{1}{8}\frac{1}{10}$  inch. Habitat.—Pond water.

The tentacles extend until once and one-half to twice as long as the diameter of the body. They are usually surrounded externally by a spiral, thread-like film, or by irregular transverse or circular folds of sarcode distinctly visible with even a comparatively low amplification. These spirals, when the tentacle is retracted, are apparently forced close together and seem often to coalesce and form an irregular protoplasmic mass at the point of attachment to the body, as if the tentacle had for its basis a rigid, internal, hollow filament which, when drawn into the body, was partially stripped of the external investment in its passage through the cuticular surface of the zooid. That this internal support or rigid lining exists is scarcely possible, yet the outer wall of the tubular tentacle seems unusually firm. When first placed on the glass slide for examination and subjected to slight pressure of the cover, the creature has the habit of voluntarily throwing off the tentacles apparently in contact with the cover, which then float away as delicate, rod-like filaments with a loop or bulb at each end, as shown in fig. 10. The separation is quickly accomplished, and the tentacle at once assumes the aspect of a fine thread, an anterior bulb or loop being formed from the capitate extremity, and a posterior one apparently from the protoplasmic contents. Other tentacles are almost immediately substituted, a fact militating against the apparent possession of a rigid tubular foundation. A similar separation takes place after submission to prolonged observation and the consequent deoxygenation of the water. What useful purpose this



voluntary mutilation can subserve it is not easy to conjecture, and why the suctorial organs are not withdrawn and this waste of substance prevented it is equally difficult to imagine. Can the infusorian be without the ability to entirely withdraw the tentacles when once extruded? The suggestion seems plausible, and, indeed, I have not yet observed an individual without some trace of these organs protruding from the surface. In several instances tentacles have been partially withdrawn, and the extremity of the crowded external spirals of sarcode below the capitulate bulb have become divided into numerous long, fine, vibratile filaments, as shown on two tentacles in fig. 10. This formation has been observed only after the infusorian has been in confinement for a considerable period. It is therefore probably an evidence of discomfort or a symptom of pathological change. Two tentacles on the same individual have been seen in this condition, but the infusorian did not appear to be weakened or ill at ease, as the remaining ones were fully extended, or actively withdrawn and protruded. The appearance has not been previously observed, and it needs an explanation which is indeed difficult to make.

TRENTON, N. J.

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### The Microscopical Discrimination of Blood.\*

BY C. M. VORCE, F. R. M. S.

After what has already been written on this subject (vol. iv, p. 223, vol. v, p. 17) it is now desirable to detail some practical applications of the facts recited. By many persons the subject is treated as if it were a matter of great and natural difficulty, while the fact is there is no other inherent difficulty than the necessity of care and the choice of proper methods. As the result of considerable experi-

ence, I consider that the practical requisites for accurate measurements of blood corpuscles and the examination of blood stains are:—

1. Homogeneous immersion objectives of powers  $\frac{1}{8}$  to  $\frac{1}{12}$  or upwards with good working distance. The objectives should be non-adjustable, or else the adjustment should be fastened so as to be incapable of movement after being once correctly adjusted.

2. Eye-piece and tube-length to give 1,000 to 1,500 diameters or upwards.

3. Eye-piece micrometer to give measurements to  $\frac{1}{80000}$  inch or finer.

4. Fine adjustment to move body and not nose-piece.

5. Mechanical stage and good sub-stage achromatic condenser.

6. A quiet work-room, free from noise or tremor.

The methods of treatment may be various, but all comparisons should be by absolutely the same method.

It may prove of interest to describe some methods chosen from actual experience, and the results obtained thereby. For this purpose the processes followed and results obtained in an investigation undertaken at the request of the authorities in one of the interior counties of Ohio, in a murder case lately tried there, will be briefly given.

In the case in question certain blood stains on wood, steel, felt, cotton cloth and woollen cloth were submitted for examination, with a view of determining whether stains of human blood could be distinguished from stains of the blood of other animals, especially the dog. The stains were upon the hat and clothing of the accused person, and upon the bit and helve of an axe found on his premises. As to the stains on the prisoner's clothing, he accounted for them by claiming that he had suffered with bleeding at the nose on the night in question; as to the axe he professed entire ignorance.

The examination was conducted in

\* This article was originally written in the fall of 1884 as a conclusion of the author's previous articles on the subject, but, being withheld for revision, was mislaid, and for a time lost.

the laboratory of the writer by Dr. Tuckerman, of this city, jointly with the writer, and occupied several weeks' time. We worked at it nightly for some three weeks, usually devoting from five to seven hours to the work each evening. Afterwards less time was given to it, but the work was steadily pursued. Of the numerous objectives tried, we finally settled upon a homogeneous immersion  $\frac{1}{10}$  by Gundlach, which proved admirably suited for the work on account of its relatively great working distance. This quality in an objective is essential in working on stains, though not important for work on fresh or spread blood. After trying many processes and media we finally adopted the following method:—The blood stain was scraped with a knife blade and the dust received on a clean glass slip; to this was added a drop of distilled water and a cover glass was laid on. After three minutes a blotting strip was applied at one edge of the cover and a watery solution of eosin at the other; after acting one minute this was in like manner drained away and a solution of chloral hydrate 40 grains to 1 ounce applied. As soon as the eosin solution was wholly replaced, the slide was wiped around the cover with a dry blotter, and the cover cemented down with gold size or Folsom's finish, and the mount at once examined.

Our tests seem to show conclusively that after the chloral is applied no further change takes place in the corpuscles enclosed. Having settled on this method, all the tests considered in reaching a conclusion were made strictly according to it, although it should be noted that all the tests by other methods, and they were many, were entirely corroborative of those by this method. Casting the image of the corpuscles enlarged about 4,500 diameters upon a screen was tried, but abandoned as it required too much time and seemed no more certain than other methods. The difference between the corpuscles of human and

dog's blood is, however, shown with striking effect by this method. The average human corpuscle will measure about  $1\frac{3}{8}$  inches, while the largest dog's corpuscle will hardly exceed  $1\frac{1}{4}$  inches, and the average will be about  $1\frac{1}{8}$  inches (1.357, 1.278, 1.164).

Although measurements made by the camera lucida, or with the cobweb micrometer, are doubtless sufficiently accurate for the purpose, there are theoretical and practical sources of error which, though minute, are not found in the use of the eye-piece micrometer, and the latter was used by us exclusively in the tests relied on, it being removed from its mount and cemented in the eye-piece used, so that the same spaces were always used in making the measurements, having previously determined that the spaces used were exactly equal within the limits of any test we could apply with over a dozen stage micrometers.

The reagents used were from the same bottles throughout, which were kept corked with scrupulous care; pipettes were drawn to capillary points, and any change in strength of solutions due to evaporation thus guarded against; in short, we taxed our combined ingenuity to secure absolute identity of conditions in all the comparative tests. The blood of ten different kinds of animals was measured, a varying number of each kind, but the greatest attention was paid to that of the dog and man. Usually 100 corpuscles on each slide were measured, an equal number by each of us, 25 at a time, thus distributing as equally as possible any effects of personal equation, or variation of the specimen. The average of the 100 measurements was then tabulated for comparison. In addition to the measurements of known bloods, slides were prepared, in several series, by Dr. Tuckerman, and submitted to me with labels marked with symbols of significance unknown to me, which specimens I would measure and record, and then substitute labels of significance unknown to him and let him measure



them and record, and we would then compare our respective results.

For present purposes we may confine our attention to the comparison of the measurements of human and dog's blood, although I am far from confident that dog's blood is that most likely to be mistaken for human. Not to weary the reader with voluminous tables, the result is summarized as follows by giving the maximum, minimum, and average measurements in each specimen, taking in every case the specimens giving the largest and the smallest average, also the average of these two, and the average of all of that kind. The measurements are given in terms of the eye-piece micrometer used.

Specimen.	Mini- mum.	Aver- age.	Maxi- mum.	Gen. av- erage.	Aver- age of all.
Human dry, -	2.00	2.402	2.60	2.3885	2.40
Ditto, - -	2.00	2.375	2.60		
Dog dry, - -	1.80	2.157	2.60	2.1315	2.153
Ditto, - -	1.80	2.106	2.40		
Human on steel,	1.80	2.270	2.60	2.1210	2.23
Ditto, - -	1.80	1.972	2.30		
Dog on steel, -	1.60	1.840	2.40	1.80	1.779
Ditto, - -	1.40	1.760	2.20		
On axe-bit, -	1.90	2.300	2.60	2.148	2.094
Ditto, - -	1.60	1.996	2.30		

Who could reasonably doubt that the blood on that axe-bit was human blood instead of dog's blood, if it was either?

This difference between the measurements of human and dog's blood may seem to some supercautious persons to be a very small basis on which to rest a conclusion from which such important results as the decision of a capital case may ensue. But such a difference, if found to be constant, is more certain and reliable than the identification of a person by the features or clothing simply; and is it ever objected that because persons are constantly being misidentified because of chance resemblance of their faces, persons, or clothing to those of other persons, therefore such evidence of identity, when offered, shall not be received and given its due weight?

Probably the cases of doubtful identity are few where a conscientious witness would testify that he could identify the party in question by his features alone with absolute

certainty or beyond the possibility of a doubt; but he might very properly claim to do so beyond a reasonable doubt, and this is all the honest microscopist will ever claim for his identification of blood.

I am, however, while aware of the difficulties which encompass the matter, and with a full sense of the momentous results to be affected, convinced, after the investigations detailed and the examination of the subject, that the careful and skillful microscopist may, after some experience, justly claim so much of certainty for his determination that it is beyond a reasonable doubt of correctness.

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### Provisional Key to the Classification of Algae of Fresh Water.— III.

[Continued from page 114.]

#### II. ORDER SIPHONÆ Kirchner.

Vegetative thallus composed of a single, anastomosing, tubular or bladder-like, comparatively large cell; the upper part, growing in air or water, produces chlorophyll, the lower part a colorless, often much branched, hair-root.

[A large order, with only two genera represented in fresh water. The strictly unicellular nature of the fronds is not in all cases constant throughout the life of every species, but it appears to continue in every case until the reproductive process is about to begin.]

#### FAMILIES.

Plant terrestrial, spherical, green, with branching, subterranean rhizoid. BOTRYDIACEÆ, IV.

Thallus filamentous, green, branching. VAUCHERIAACEÆ, V.

#### Family IV. BOTRYDIACEÆ.

Thallus terrestrial; composed of an aerial green part, and a subterranean, colorless, branching, root-like part.

Propagation by copulation of swarm-spores giving rise to a zygospore, from which a new vegetative plant grows.

The contents of this are transformed into an indefinite number of resting-spores, the contents of which become converted into a number of sexual, copulating swarmspores (microzoospores).

Propagation also by cell-division and formation of asexual swarm-cells (macrozoospores).

### 53. Genus *Botrydium* Wallroth.

Vegetative plant, a large, green, single cell, spherical or balloon-shape above the ground, tapering downward to a colorless, branching subterranean root (rhizoid).

Propagation by cell-division, formation of uniciliate zoospores, and copulating biciliate zoospores.

By division of the aerial portion an outgrowth is divided off which grows to the size of the mother-cell, develops a rhizoid, and finally becomes a separate plant.

The contents of the cell (zoosporangium) may divide into numerous macrozoospores, each with one cilium, which escape, lose their cilia, acquire a membranous covering and germinate (*Protococcus botryoides*) on moist earth.

The contents of the green cell may also give rise to a number of spores, at first green, changing to red (*Protococcus coccoma*, *palustris*, *botryoides*), which in water produce biciliate zoospores (microzoospores). These copulate and form spherical zygosporos (also named isosporos). These may germinate immediately, or pass into a resting condition.

[The processes of propagation are variously modified by the conditions of growth, especially by the amount of water present. The phenomena that have been observed are confusing and difficult to understand, but they afford an excellent example of adaptation to changing conditions.]

### Family V. VAUCHERIAEÆ.

Thallus filamentous, rather robust, unicellular, aerial and aquatic, large. The entire plant is a single, long tube, usually branched. The protoplasm forms a thin layer on the walls, in

which are chlorophyll-grains, and oil-drops. Usually there are hair-roots at the lower end.

Sexual propagation by oogonia and antheridia. Oogonia spherical, lateral on the frond, stalked or sessile. Antheridia colorless, polymorphic, lateral on the frond, within which form numerous spermatozoids, which escape through an opening, enter the oogonia, and fertilize the oosphere. The resulting oospore is inclosed by several coats. After a period of rest it germinates and grows to a new plant.

Asexual propagation by gonidia, which in many species are motile, in others not, and germinate in a short time.

### 54. Genus, *Vaucheria* De Candolle.

Oogonia and antheridia produced in indefinite number near together on the same individual, sessile or on pedicels. Antheridia either sac-shape or elongate and curved cells; spermatozoids elongate, with two cilia usually of unequal length.

Zoospores formed in terminal cells, which are divided off from the filaments by a septum after an accumulation of dark protoplasm occurs at the ends. A single spherical or oval zoospore is formed in each cell, which escapes by an opening. The motile zoospores are covered with cilia, and after a short time they come to rest and germinate. The motionless ones likewise germinate soon after their escape.

[The life-history of *Vaucheria* has been presented in an interesting manner on pages 2 to 6 of the current volume. The species are numerous.]

[To be continued.]

### Improved Microscope Objectives.

The following notice of the recent work of Mr. Gundlach has been sent to us by a correspondent, which we publish for the information of our readers. The new lenses are worthy of a trial:—



The Gundlach Optical Company of Rochester N. Y., are now making their microscope objectives after the new principle discovered by Mr. Gundlach, and described by him in a paper read before the American Society of Microscopists, at the meeting at Rochester last August. Their water-immersion, glycerin-immersion, and dry objectives made upon this plan are especially well spoken of. With a  $\frac{1}{10}$  glycerin objective a well-known microscopist of Ohio has succeeded in clearly resolving *Amphipleura pellucida*, in balsam, with simple mirror illumination, without any accessory apparatus. The same gentleman with a  $\frac{1}{8}$  dry objective has resolved *A. pellucida* in a medium of 2.42 refractive index.

The water-immersion objectives have a very long working distance, and the observations of higher order are corrected to a much higher degree than was heretofore possible in a water-immersion objective; hence these objectives have a definition and resolving power found in oil-immersion objectives only. This series of objectives may therefore be regarded as a new improvement in the field of microscopic apparatus, a water-immersion objective of highest optical quality having also a long working distance. The objectives are provided with collar adjustment.

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### Staining Tissues in Microscopy.\*

#### III.

BY PROF. HANS GIERKE.

[Continued from p. 107.]

AMMONIUM MOLYBDATE.

49. Merkel. Von Henle in seinem Handbuch der Nervenlehre des Menschen. Braunschweig, 1871. Band III d. Handbuch d. Anat. d. Menschen mitgeteilt.

Dilute 1 part saturated solution of ammonium molybdate with 1-2 parts water, add a pinch of limatura ferri.

Add drop by drop, with constant stirring, sufficient hydrochloric acid to produce a dark blue, nearly black. The cloudy white precipitate formed at first soon dissolves by stirring, but if the solution turns brown it is worthless. After ten minutes filter. It will be found particularly adapted for nerves, sections of which stain in from 6 to 15 hours.

#### 50. Krause.

In various hand-books, as Frey 7th ed., Thanhoffer, and Dippel, Krause is named as discoverer of a method of staining with ammonium molybdate. He stains dark blue in about 24 hours with a 5% solution in water. Stainings may be made brown by subsequent treatment with 1% sol. tannic acid or 20% pyrogalllic acid. The stain is recommended for nerves, glands, and ciliated cells.

#### MADDER DYES.

51. Lieberkuhn. Müller's Archiv. 1854 u. Ueb. d. Wachsthum des Unterkiefers u. der Wirbel. Sitzber. d. Ges. z. Beförderung der ges. Naturwiss. Marbg., 1867, No. 10.

Living animals were fed with madder to study the formation of bone, the dye uniting with the forming bony matter.

52. Kölliker. Die normale Resorption des Knochengewebes. Leipzig, 1873.

Same process as 51 ante.

53. Lieberkuhn. (1) Ueber die Einwirkung von Alizarin auf die Gewebe des lebenden Körpers. Marburger Sitzungsber, 1874, p. 33, u. (2) Ueber das Verhalten des Alizarin (l. c. p. 77).

After feeding pigeons on madder the dye unites with the lime salts of the bones, but not with the organic matter. The latter may be removed by boiling in soda solution without injury to the dye. By injecting a 5% solution of sodium-alizarin into dogs, stainings were obtained—in young dogs the entire bones, in old ones the inner surface only, became red.

\* From the Zeitschrift für wissenschaftliche Mikroskopie. Translated for this JOURNAL by Prof. Wm. H. Seaman, M. D.

A chemical union between the calcium phosphate and the dye occurs, while the calcium carbonate is unaffected. In three days the alizarin disappears from the blood and other organs. It may be found temporarily in any part of the system, as in lymph, gall, urine, feces and saliva, but is not permanent.

54. Strelzoff. Genetisch-topographische Untersuchungen des Knochenwachstums. Unters. a. d. Pathol. Inst. zu Zürich, herausg. von Eberth. 1874. H. 2, p. 83.

Confirms Lieberkuhn's statements that the madder unites with inorganic portions of the bones.

55. Benczur. Augegeben in v. Thanhoff, Das Mikroskop und seine Anwendung.

Von Thanhoff describes an alcoholic solution of alizarin as recommended by Benczur for staining large nerves. The sections should remain twenty-four hours in the dye. The cells and axis of the preparations will be light brownish red. The contents of the cells and the axis will be sharply differentiated.

56. Ranvier. Des applications de la purpurine à l'histologie. Arch. d. Phys. 1874. p. 761.

Dissolve purpurin in a boiling solution of alum 1-200 of water. Add  $\frac{1}{4}$  part alcohol. The solution is an orange-red. It dyes strongly the periosteum, cornea, and nucleus of cartilage cells, bones, etc. Bioplasm remains uncolored. This stain is much to be recommended for the spinal marrow hardened in ammonium bichromate, but specimens treated with chromic acid and Müller's fluid are not good. In the spinal marrow the nuclei of connective tissue and of capillaries become red, but the nuclei of nerve cells remain colorless. It becomes thus a means of differentiating nerves from connective tissue.

57. Grenacher. In hand-books of microscopy.

Dissolve a pinch of purpurin in a

1-3% solution of alum in glycerin, pure or slightly diluted. After staining 2-3 days, filter. Keeps longer without a precipitate than Ranvier's solution of purpurin, and stains in from 10-30 minutes.

#### VARIOUS DYES.

58. Waldeyer. Ueber den Ursprung und Verlauf des Axencylinders bei Wirbelthieren und Wirbellosen. Zeitschr. f. rat. Med. 3. Reihe, Bd. xx. 1863.

To stain the axis of nerve fibres without staining the sheath, a watery solution of the coloring matter of alkanet root is recommended. An extract made with turpentine has also done good service, producing similar effects.

59. Dippel. Das Mikroskop, 2 Aufl. p. 721. 1882.

Uses an alcoholic tincture of alkanet in vegetable histology. It serves particularly to distinguish resins and fats, which color a deep red while protoplasm only takes a rosy tinge. Dippel thinks it would be useful for animal tissues.

Hartig. See No. 2. Alkanet, like carmine, tends to concentrate in cell nuclei. 1854.

60. Lawson Tait. On the freezing process for section-cutting and on various methods of staining and mounting sections. Jour. Anat. and Phys., vol. ix, p. 250. 1875.

Tait rejects anilin dyes and carmine and strongly recommends litmus. Boil powdered litmus in water, filter, add a little alcohol. The sections color uniformly deep blue. By adding a very little nitric acid a brownish red is obtained. Wash quickly and thoroughly, and the nuclei will be blue, the rest of the tissue a rose pink.

The leaves of the red cabbage extracted with water or alcohol may be used with good results. The addition of ammonia gives a green, of acid a purple. But these are temporary stains and not permanent. For quindolein and cyanin see the anilins.



## INDIGO-CARMINE.

61. Thiersch. Injectionsmassen von Thiersch u. W. Müller. Arch. Mikr. Anat. Bd. 1. 1865.

Make a saturated solution of indigo-carmin in oxalic acid (1:22-30 of water). Dilute with alcohol. When strong gives intense blue in a few hours. Cells and nuclei are colored, and any excess may be removed by oxalic acid. Introduced into the bodies of living animals indigo-carmin is taken up by the tissues and again separated. Without attempting to analyze the relations of this process with staining proper, an abstract of its literature is given here on account of its importance.

62. Chrzonszczewski. (1) Centelbl. f. d. Med. Wiss. 1864. No. 38. (2) Arch. pathol. Anat. Bd. xxxv, p. 135. 1866.

Chrzonszczewski discovered this method, by introducing colors into the blood of living animals, and studying their excretion by the urinary capillaries.

63. Diaconow. Medicinisch-chemische Untersuchungen. Berlin, 1867. p. 245.

Indigo-carmin introduced into the stomach or the blood is taken up and then separated by both liver and kidneys. Other tissues do not absorb it, it is not found in the lymph or serum of the blood.

64. Heidenhain. (1) Arch. Mikr. Anat. Bd. x. p. 30. (2) Arch. f. d. ges. Phys. Bd. ix. p. 1. (3) Hermann. Handbuch d. Physiologie. Bd. v, p. 345.

Applies the above processes to show that the urinary tubuliferi separate soluble material and the Malpighian glomerules of the kidneys separate the water.

65. Arnold. Arch. f. path. Anat. u. Phys. Bd. lxiv, p. 203; Bd. lxv, p. 77; Bd. lxvi, p. 77; Bd. lxviii, p. 465; Bd. lxxiii, p. 125; Centralbl. f. d. med. Wiss. 1875, No. 41 u. 51. 1875 bis 1878.

66. Thoma. Centralbl. f. d. med. Wiss. 1875 No. 2. Arch. path. Anat. u. phys. Bd. lxiv, p. 294.

67. Küttner. Arch. f. path. Anat. u. Phys. Bd. lxv, p. 12; Bd. lxvi, p. 12, Centralbl. f. d. Med. Wiss. 1875, No. 41.

68. Gerlach. Centralbl. f. d. Med. Wiss. 1875, No. 48. Ueber das Verhalten des indigenschwefelsauren Natrons in dem Knorpelgewebe lebender Thiere. Habitations-schrift. Erlangen, 1876.

69. Nykamp. Arch. Mikr. Anat. Bd. xiv, p. 492.

70. Zeller. Arch. path. Anat. u. Phys. Bd. lxxiii, p. 257.

Nos. 65 to 69 treat of the separation of sodium sulphindigotate in the gelatinous matter between the epithelium cells and the walls of the vessel. Nos. 65, 68, 69 especially of cartilaginous tissues. Küttner examined the separation of the color by the basal portions of pulmonary epithelium, and Zeller the same in certain glands of frogs.

Arnold (in Arch. f. path. Anat. u. Phys. Bd. lxvi) gives a description of apparatus for the slow injection of colors into the abdominal vein of frogs.

Sodium sulphindigotate has been employed in double staining, which see.

[To be continued.]

### The Chromatoscope.

Some time ago Mr. J. D. Hardy devised an instrument, which he has named a chromatoscope, so easily made by any one who has a spot-lens that we take the following description from the *Journal* of the Royal Microscopical Society:—'Its chief purpose is that of illuminating and defining objects which are non-polarizable, in a similar manner to that in which the polariscope defines polarizable objects. It can also be applied to many polarizable objects. This quality, combined with the

transmission of a greater amount of light than is obtainable by the polariscope, renders objects thus seen much more effective. It is constructed as follows:—Into the tube of the spot-lens a short tube is made to move freely and easily. This inner tube has a double flange, the outer one (which is milled) for rotating, and the inner one for carrying a glass plate. This plate is made of flat, clear glass, and upon it are cemented by a very small quantity of balsam three pieces of colored (stained) glass, blue, red, and green, in the proportion of about 8, 5, and 3. The light from the lamp is allowed to pass to some extent through the interspaces, and is by comparison a strong yellow, thus giving four principal colors. Secondary colors are formed by a combination of the rays in passing through the spot-lens.

‘The stained glass should be as rich in color and as good in quality as possible, and a better effect is obtained by three pieces of stained glass than by a number of small pieces. The application of the chromatoscope is almost unlimited, as it can be used with all objectives up to the  $\frac{1}{8}$ . Transparent objects, particularly crystals which will not polarize, diatoms, infusoria, palates of molluscs, etc., can not only be seen to greater advantage, but their parts can be more easily studied. As its cost is merely nominal, it can be applied to every instrument, large or small, and when its merits and its utility by practice are known, I am confident that it will be considered a valuable accessory to the microscope.’

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— Prof. W. O. Atwater, as the results of a series of experiments, finds, contrary to the general opinion of chemists, that plants assimilate nitrogen from the atmosphere. They take up the greatest quantity when supplied with abundant nourishment from the soil. Well-fed plants acquired fully one-half their total nitrogen from the air. It seems probable that the free nitrogen of the air is in some way assimilated by the plants.

## EDITORIAL.

**Publisher's Notices.**—All communications, remittances, exchanges, etc., should be addressed to the Editor, P. O. Box 630, Washington, D. C.

Remittances should be made by postal notes, money orders, or by money sent in registered letters. Drafts should be made payable in Washington, New York, Boston, or Philadelphia.

Subscription-price before April 1st, \$1 per year, in advance. All subscriptions begin with the January number. After April 1st the subscription-price will be \$1.50.

The regular receipt of the JOURNAL, which is issued on the 15th of each month, will be an acknowledgment of payment.

The first volume, 1880, is entirely out of print. The succeeding volumes will be sent by the publisher for the prices given below, which are net.

Vol. II (1881) complete, \$1.50.  
Vol. III (1882) complete, \$2.00.  
Vol. IV (1883) complete, \$1.50.  
Vol. V (1884) complete, \$1.50.  
Vol. V (1884), Nos. 2-12, \$1.00.

**SCIENTIFIC MEETINGS.**—The A. A. S. meets this year at Ann Arbor, Mich., on the 26th of August. A large attendance is anticipated and plans for the meeting are well advanced, calculated to make an interesting one.

The American Society of Microscopists meets at Cleveland, where great preparations are under way for the occasion. A circular concerning this meeting will be found inserted in this number of the JOURNAL. Press of matter this month forbids further notice of either of these meetings.

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**THE POSTAL CLUB.**—A few weeks ago Dr. Ward gave us a short but thoroughly satisfactory account of the condition of the Postal Microscopical Club. He said the affairs of the club were being closed up for the year, ‘with every vow fulfilled,’ ‘all the circuits being now upon the last box of the number assigned when we started last fall.’ No other boxes will be sent out until September.

We can understand the satisfaction the officers of the Club must feel at such a result. It has only been secured by having a careful system whereby the course of every box can be followed throughout its migrations, and wherever there is delay the cause can be promptly discovered and removed. Efficient management in ad-



dition to such a system has resulted in a successful year, satisfactory to the members as well as to the officers.

Our monthly notices of the boxes as they come to this circuit may or may not be of value. They serve as a record of what passes through the circuits each year, and for this, if for no other reason, we purpose to continue them. Merely as a record they will be of interest to some of the members, and if the few words of commendation or criticism that occasionally appear result in improving the character of the preparations, or lead contributors to add more information concerning their preparations in the letter package, we shall be much pleased at the result.

The preparations as a whole are not yet what they should be. During the year just passed there has been a noticeable improvement over previous years, but there is still room for much better work. Each member is only called upon for a single preparation during a whole year, and it seems as though that one should be one of the best, and, even if the preparer merely uses the microscope for pastime, a few hours' study will enable him to write a description of it that will add greatly to its value to others like himself.

The annual report of the Club for the year 1884 has recently come to hand. The Club has now been in existence ten years. There are twenty-two circuits of six members each. During nine months of 1884 one hundred and ten preparations passed through every circuit. The Managers say:

'Of the slides contributed last year, many were of great interest, and the average was probably as high as could be reasonably expected. Some members have desired that a censorship of slides be provided, in order to secure objects of a high grade; but no plan has been suggested which would not occasion increased labor and impracticable delays. The selection is therefore left to members themselves, trusting to their offering things worthy of

study, and avoiding so far as possible the duplication of objects frequently circulated. Valuable special boxes representing original work have been contributed during the year by Messrs. J. Kruttschnitt, J. M. Adams, and Geo. Timmins. In judging of the circuit boxes, those few persons who have extraordinary facilities for securing material and making superb slides should remember that there are learners as well as teachers, and that those fellow-workers whose opportunities for intercourse at the centres of learning are most limited are often those who need the privileges of the Club most definitely and prize them most highly; that a club composed of a few experts of equal advantages would be of a selfish character, and greatly limited in size and usefulness; and that unpretending slides have often contained points of interest to the most experienced members.'

Empty boxes for new preparations will be sent out soon, and members should have their contributions ready so as not to delay the boxes.

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STUDIES OF AMOEBÆ.—Dr. August Gruber, of the University of Freiburg, has published a valuable contribution of 38 pages\* and three large colored plates, describing his observations on amoebæ. The special object of these investigations was to establish, if possible, some characters by which the different species can be identified. In this the author believes he has succeeded. To accomplish the result, it was necessary to study the different species for long periods of time, in order to discover any modifications of form they might undergo. During nine months no indication of transformation was observed in the species studied, but all were sharply defined, and showed at the end of the year the same peculiarities of structure. These observations were conducted upon specimens collected from a small pond, and the same species in

\* Studien über Amöben. Leipzig.

an aquarium. The attempt to cultivate them separately in small glasses failed, as they would not multiply. In this respect our own experience has been more fortunate, for several years ago we succeeded in watching the multiplication of a species that was very abundant in a one-ounce vial, in which was a spray of *Anacharis*. The bottle was covered with a watch-glass, and the amœbæ multiplied rapidly and were abundant for months.

The species principally observed was *Pelomyxa villosa* Leidy. A number of species are carefully described, but we can only give the names of the new species in this place, which are named *Amœba prima*, *secunda*, *tertia*, *quarta*, *quinta*, all of which are related to *Pelomyxa*, and are thrown together by Prof. Leidy, and *Amœbalucida*. A general account of various other amœbæ follows:

The diagnosis of an amœba must be based upon several features the average size, consistence of the protoplasm, and through this the character of the movements, the kind of inclusions in the protoplasm, such as vacuoles, granules, crystals, the parasitic living filaments of fungi, and the constituents of food; but especially the number, size, and structure of the nuclei.

The contribution is one of great interest for the value of the observations on the peculiarities described as well as for the systematic treatment.

SYNOPSIS OF DIATOMS.—To subscribers to the Synopsis of Diatoms we have to announce that the volume of text, containing three supplementary plates, was issued some time ago, and a consignment of a sufficient number to complete all the sets has been received for us at the custom-house in New York, where it has been for a fortnight. Eventually it will reach us, and subscribers will be promptly informed of it. In case we should receive it before the JOURNAL goes

to press this month, announcement of the price will be made in our advertising columns.

The price of the complete work has been placed at \$58.30. This is much more than our subscribers have paid; but the edition is nearly exhausted and the price has been raised.

We would say for the benefit of those persons who are interested in diatoms that, on the occasion of a fire in our New York office two years ago, a considerable number of plates of the Synopsis were injured by water, so as to be unfit for sale in the complete sets. These injured plates belong to fascicle VI. We have several sets, almost complete, of the injured plates of this fascicle, which we will send to subscribers to the JOURNAL for fifty cents, and ten cents additional for postage. They will be sent on approval on receipt of the amount.

RECENT PROGRESS IN THE IMPROVEMENT OF THE MICROSCOPE.—The article on 'Microscopy' in Appleton's 'Annual Cyclopaedia' for 1884, written by Dr. R. H. Ward, has already been mentioned in these columns. We have since received a proof copy from the author, which has been carefully read, with great interest. The author begins with the simple microscope, describing some of its forms, and the different kinds of supports useful for dissecting and other purposes. He then describes the modern form of stand, and says that there is now a distinctive American form of stand, differing from the English model formerly extensively copied in this country, and from the continental model. The American stands 'combine nearly all the simplicity and portability of the continental stands with nearly all the efficiency and scope of adaptations of the more ambitious English instruments.' As types he mentions the 'histological' stand of Mr. Bulloch as a 'very simple and inexpensive form yet efficient for a great variety



of scientific work,' and the Bausch & Lomb 'universal' as one of the more elaborate ones.

Among the improvements during the past six years are mentioned a broad body to receive oculars of wide field, the broad-gauge screw for objectives, short body with draw-tube, the Jackson model universally adopted, the pinion of the coarse adjustment high up on the limb, and the various improvements in the fine adjustment by various makers; the stage is round and revolves around the optic axis, and has various adjustments; the swinging substage and mirror-bar, moving independently or together; the various forms of concentric stands in which the body is supported on a sectoral limb, instead of swinging on trunnions.

We cannot mention all the improvements that should be included under this head. The new method of mounting the Wenham prism used by Messrs. Bausch & Lomb, and the Abbe binocular eye-piece, are notable improvements in the binocular. Improvements in objectives have been very great, and we cannot enter upon a notice of this part of the subject. We must not fail, however, to give the ideal series of objectives recommended by the author, which is as follows:—

Focus. Inches.	Amateur.	Professional.	Expert.
4	—	9°	12°
2	12°	—	—
1	—	25	30
$\frac{3}{4}$	35	—	—
$\frac{1}{2}$	—	—	—
$\frac{1}{4}$	—	110	75
$\frac{1}{8}$	—	—	—
$\frac{1}{16}$	140	—	140
$\frac{1}{32}$	—	n. a. 1:20	—
$\frac{1}{64}$	—	—	n. a. 1:40+

From this it will be seen that Dr. Ward favors moderation in regard to angular aperture.

Without extending this notice to undue length, we can only say that the author has covered the field well, and has given a very instructive as well as interesting account of im-

provement in microscopical appliances and methods. The result seems highly creditable to American ingenuity and skill. It shows that there is a constant demand for microscopes of the most perfect form, which has been an inducement to our makers to improve them until the American model has become the best.

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JAMES C. LATHROP.—Mr. James C. Lathrop, of Bridgeport, Conn., died on the thirty-first day of May, at the age of 33 years. Mr. Lathrop was well known to scientific men in the East, and was one of the most active members of the Bridgeport Scientific Society. As a mineralogist he was particularly well-informed; his collection of minerals is said to be the most complete in the State, all his specimens have been carefully selected, and many of them are among the finest of their kind. In other branches of science he was an enthusiastic student and teacher, whose influence was felt in the community. He was a good observer with the microscope, of which he made much use. For nearly twelve years he has been an accountant and cashier for the Housatonic Railroad Company.

It is seldom that a man in active business acquires such accurate and extended knowledge in science as Mr. Lathrop possessed. Naturally active and quick in thought and apprehension, by close application during the hours that could be spared from business and home duties he became a leader among his associates, and an example worthy of imitation. The few hours it was once our good fortune to spend at his home gave us an insight into his character and attainments, and we can best express our recognition of his worth by saying that the world can ill afford to lose the influence and example of such a man.

He has left a wife and four bright children, who, with many friends, will deeply feel their loss.

## NOTES.

— Mr. Walmsley has become a liberal contributor of ingenious devices for photographers within the past year or two, and seems to be as much interested in amateur photography now as he has been in microscopy for many years. Walmsley's excelsior lantern is a new device for the dark room, which is much cheaper than some lanterns that are certainly not better. We also read of Walmsley's folding pocket lantern, phantom instantaneous shutter, instantograph shutter, adjustable view finder, alkaline developer, ready sensitized paper, and photo-micrographic camera.

— A most valuable article for the photographer, especially for those who have only occasionally to develop pictures, and therefore are likely to be annoyed by the deterioration of their solutions of pyrogallic acid by long keeping, is the preparation of pyrogallic acid in tablets, just called to mind by one of Mr. Walmsley's circulars. Each tablet contains two grains of the acid, which can be dissolved at the moment of use, and thus a fresh solution is always at hand, and there is no trouble about weighing.

— Some measurements of blood corpuscles have been made by Henry L. Tolman and Marshall D. Ewell, M. D., the results of which are recorded in *The Western Druggist*. Mr. Tolman worked with a Spencer homogeneous immersion  $\frac{1}{10}$ , n. a. 1.27, with an eye-piece micrometer in a  $\frac{3}{4}$  inch ocular, the value of each division being  $\frac{1}{8000}$  of an inch. Dr. Ewell used a Spencer  $\frac{1}{10}$ , n. a. 1.35, a Bausch & Lomb amplifier, a Bulloch cobweb micrometer, each division of which represented  $\frac{1}{1000000}$  of an inch. The results are thus tabulated:

	Corpuscles.	Largest.	Smallest.	Average.
Tolman ...	50	$\frac{1}{8700}$	$\frac{1}{8638}$	$\frac{1}{8669}$
Ewell .....	25	$\frac{1}{8817}$	$\frac{1}{18831}$	$\frac{1}{8188}$

— It was stated by Mr. J. J. Coleman, in an address before the Philosophical Society of Glasgow, that microbes in animal flesh are not killed by the intense cold of  $-86^{\circ}\text{C}$ . According to experiments of his own and Prof. McKendrick, microbes alive before the freezing are again brought into activity by heat and moisture.

— *Hedwigia, Organ für Specielle Kryptogamen kunde nebst Repertorium für Kryptogamische Literatur*, begins its twenty-fourth volume, enlarged, and in a new dress. We are pleased to note this

change, and trust that it will be met with substantial appreciation by students of the cryptogams. The first number of this year contains an important article on new species of the genus *Riccia*, by F. Stephani, illustrated by a plate. *Hedwigia* is edited by Dr. G. Winter, and is published in Dresden.

— A valuable report on the Purification of Drinking Water by Alum, by Professor P. T. Austin and F. A. Wilbur, has been issued from the chemical laboratory of Rutgers's College. It has been found that the addition of about 1.5 grains of alum to a gallon of water will cause suspended matters to subside in the course of two days or more, leaving the supernatant water clear. For domestic use the water may then be filtered clear through a filter of cotton batting pressed into the neck of an inverted, bottomless bottle, a few minutes after the addition of alum. It is presumed, with good reason, that in this way not only are suspended matters removed from the water, but albuminoid and perhaps other organic matters are also precipitated, or at least rendered incapable of supporting the life of microbes. The quantity of alum required is not sufficient to be detected by taste, and, indeed, only the slightest trace of alumina could be detected by chemical tests in the water thus treated, after the sediment was removed. The method seems to be eminently practical.

— The annual reception of the San Francisco Microscopical Society was given on the evening of May 19th. Thirty-eight objects are named on the programme, one for each microscope. According to the report that has reached us the display of objects was very fine, Mr. Hyde being especially commended for the beautiful way he showed some diatoms *in situ* on a dark ground, Mr. Breckenfeld for crystals of kinete of quinia, Mr. Bates for his colony of vorticellas, and Mr. Banks for the display of the electric spark.

— We receive regularly reports of the meetings of the San Francisco Microscopical Society, which is now one of the most active of our societies. At a recent meeting Dr. J. H. Stallard demonstrated the method of cutting sections by freezing the tissues with ether spray. At a subsequent meeting Mr. Banks showed the electric spark under the microscope in its passage between the terminals of a quarter-inch spark induction coil attached to a Grenet bichromate solution battery. Two vulcanite slides had been prepared, on which were fastened adjustable platinum



strips connected with the battery wires and terminating in brushes of platinum wire of extreme tenuity. The electric fluid, in its passage from one terminal to the other, formed a very attractive object under the microscope. One of the slides was used to show the effect on the electric spark of interposing films of soot of different thicknesses. In its passage through these the current was deflected into meandering lines, around which scintillated showers of sparks. The particles of soot could be seen arranging themselves in symmetrical groupings around the terminals. In conclusion, Mr. Banks announced that he had sent for, and would soon be able to exhibit, the Stokes-Watson apparatus for showing under the microscope the combustion of various metals in the electric arc.

— There is a law of adaptation in nature which the naturalist, in whatever field he may be occupied, finds exemplified in many ways. Dr. W. Breitenbach, describing the small crustaceans which have their home on the floating islands of sea-weed of the Sargasso Sea, gives the following interesting account of them in *Popular Science Monthly* :—

'The adaptation of the innumerable tints to every grade of change in the color of the sea-weed is really marvellous. The younger, lighter green crustaceans are always to be found on the young, verdant fronds of the plant, while the older parts of the weed are inhabited by older, brown animals. The older stems are often incrustated with the white shells of bryozoa, and corresponding with these we are sure to find white spots on the brown armor of the crabs. The legs of the animals are frequently of an olive green ground with brownish spots, deceptively like the slender sea-weed leaves that are just beginning to turn brown. If one will, as I did, pull one of the large plants upon the deck, leave it in a cask of sea-water for an hour or two, and then look through it for crabs without disturbing it, he will find it very hard to discover three or four of the animals, although he may be sure there are a quarter of a hundred of them there; and, if he gives the mass a lively shake, he will find a curious assemblage of the most varied sorts tumbling off the bush, whose behavior will go far to verify Wagner's view; for, if they are allowed the opportunity, they will all swim back to the sea-weed, and each will seek a part of the plant most like it in color. I tried the experiment forty or fifty times, and

never saw a little green crab settle on a dark-brown stem. The crustaceans keep to their color, and the brown ones will, with amazing speed, dart through the thick net-work of stems and leaves, to the darkest spot they can find, where they quickly escape observation.'

— The Portland (Me.) Society of Natural History gave a microscopical exhibition on the evening of April 27th, a programme of which we are pleased to acknowledge. There are twenty-six microscopes on the list, and two objects for each. The society was incorporated in 1850, and is therefore among the older scientific organizations of the country.

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## CORRESPONDENCE.

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*Volvox Globator.*

TO THE EDITOR:—After searching nearly every pond and pool in the vicinity of Washington for *Volvox*, I found plenty and fine specimens in the heart of the city. During a drenching rain today, I made a gathering from the pond spanned by the bridge running from Center Market to Pennsylvania Avenue, and among other strange specimens was the long-sought *Volvox*. I believe I am the first to find *Volvox* in the District.

H. A. DOBSON, M. D.

MAY 29TH, 1885.

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## NOTICES OF BOOKS.

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*First Annual Report of the Bureau of Animal Industry for the year 1884.* Washington: Government Printing Office. (8vo, pp. 512.)

This valuable report is a detailed account of the investigations and general work under the direction of D. E. Salmon, D.V.M., chief of the Bureau. It contains so much that is of importance and interest that we shall not attempt a review in this place. The outbreak of pleuro-pneumonia in the West has afforded an opportunity to study some features of this disease, and especially to establish beyond question the fact of its contagious nature. A brief review of the evidence concerning the cause of the disease known as swine-plague, which Dr. Salmon's investigations have shown to be a micrococcus, is given, illustrated by two photo-micrographs. An article on the Gape Disease of Fowls, by M. P. Meguin, is translated by Dr. Theobald Smith, accompanied by a plate

showing the parasite causing the disease, *Syngamus trachealis* v. Siebold. Finally, there is a comprehensive report on Trichinae, by Dr. Salmon. We have been obliged to pass over other important subjects without notice, but this much will be a slight indication of the activity, efficiency, and importance of the newly-established Bureau of Animal Industry.

*Report of the Commissioner of Agriculture* for the year 1884. Washington: Government Printing Office. 1884. (8vo, pp. 580.)

The investigations constantly in progress in the Department of Agriculture make the annual reports of no little scientific as well as economic interest. In this volume the report of the chemist, H. W. Wiley, treats of sugar manufacture, milk and butter, their analysis and adulterations, the manufacture of flour, and other matters. The report of the botanist, Dr. Geo. Vasey, is illustrated by twenty-one plates, showing various plants. Dr. C. V. Riley's report as entomologist covers 134 pages and ten plates. It includes an account of the rust-mite of oranges, the cabbage cut-worm, and other insects.

*Science and the Supernatural.* A lecture by Prof. A. J. Du Bois, of the Sheffield Scientific School of Yale College, before the Bridgeport Scientific Society. 1885.

A lecture full of sound reasoning, clear and thoughtful, which should be read by those who have an interest in this subject. One may not be quite satisfied with the method of treatment, yet there is much food for thought in it.

*The Oleates.* An Investigation into their Nature and Action. By John V. Shoemaker, A. M., M. D., Lecturer on Dermatology at the Jefferson Medical College; Physician to the Philadelphia Hospital for Skin Diseases; Member of the Pennsylvania State Medical Society; the Minnesota State Medical Society; the American Medical Association; the American Academy of Medicine; the British Medical Association; Fellow of the Medical Society of London, etc. Philadelphia: F. A. Davis, Att'y, 1217 Filbert St. 1885. (12mo, pp. 122.)

A very useful book for the medical practitioner. Oleates, according to the author's experiments, are superior to other ointments, in that their active constituents enter the minute openings of the glands and follicles on account of being dissolved

in the fatty base and vehicle. The oleates are not absorbed and taken up by the lymphatics and conveyed to the blood, as ordinarily supposed. They do not penetrate deeper than the glands of the epidermis. The work treats of their manufacture, and their physiological and therapeutical effects.

*Manipulation of the Microscope.* By Edward Bausch. Illustrated. Published by Bausch & Lomb Optical Co. Rochester, N. Y.: Post-Express Book and Job Printing-House. 1885. (12mo, pp. 96).

This is a thoroughly practical and instructive book, very neatly printed, and for the beginner in microscopy there is nothing better. Those who have become familiar with microscopic work will find it not unprofitable reading. We are greatly pleased with the plan and systematic arrangement, as well as the concise and plain manner of treating the subject. There is nothing to criticize in these respects. The information given is just what a beginner needs. We are not quite sure, however, that the statement on page 20, 'Other things being equal, it is the angular aperture of an objective which determines the quality,' will convey the right impression. There are just grounds for the impression that an excessive angular aperture does not improve an objective; and we would say, for instance, that the half inch of 98° mentioned on page 30 would not be the best kind of a half inch. The fact is very easily demonstrated by taking a photograph of such an object as a half inch would ordinarily be used upon—some minute polycystina, for example—with such an objective, and another photograph of the same object, using the same objective with the angular aperture cut down to 30° or 40° by a paper diaphragm.

The book is one which we shall be glad to recommend to all beginners in microscopy, and to intending purchasers.

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## Exchanges.

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[Exchanges are inserted in this column without charge. They will be strictly limited to mounted objects, and material for mounting.]

Wanted: Well cleaned and selected Foraminifera, for which cash will be paid or slides given.

EDWARD G. DAY,  
Riverside, Conn.

Hundreds of varieties of fresh-water Algae, including Volvox, Desmids, Rivularia, Draparnaldia, Tetraspora, &c., &c., for selected exchanges by list.

J. M. ADAMS,  
Watertown, Md.



# THE AMERICAN MONTHLY MICROSCOPICAL JOURNAL.

VOL. VI.

WASHINGTON, D. C., AUGUST, 1885.

No. 8.

## A Practical Method of Finding the Optical Centre of an Objective, and its Focal Length.

BY PROF. W. F. DURAND, ASSISTANT ENGINEER U. S. NAVY.

The term optical centre, as usually defined in the text-books on optics, is that point in a lens through which if a ray pass, it enters and emerges in parallel lines. This definition will not exactly suit the point referred to in the following article, and it may be well to show exactly what is meant by the term.

In the diagram (Fig. 21) let  $ab$  be an object. Then it is simply a matter of experiment to show that in some way the rays radiating from  $a$ , for example, are brought to a focus at some point  $a'$  on the opposite side of the centre line, and at a distance from it depending on the distances of  $a$  from the centre line, and from the objective. Likewise the rays radiating from  $b$  are brought to a focus at  $b'$ , and thus is formed the inverted real image  $a'b'$ . Suppose that  $a$  and  $a'$  be joined with a straight line, and likewise  $b$  and  $b'$ . Without attending at all to the actual course of the rays, which, in an objective of two, three, or four systems is very complex, it is evident that  $ao b$  and  $a'o b'$  are similar triangles, and that we have

$$\frac{a'b'}{ab} = \frac{a'o}{oa} = \frac{c'o}{oc}.$$

Now,  $\frac{a'b'}{ab}$  is evidently magnification, and by the equation this equals  $\frac{c'o}{oc}$ . That is, the magnification equals the ratio of the distance of the image

from a certain point,  $o$ , to that of the object from the same point. If

the position of  $o$  be known, it is evidently an easy matter to find the magnification when the positions of  $c$  and  $c'$  are known. Furthermore, if we wish to adopt the 10-inch standard for the vague quantity called tube length,  $o$  is evidently the point from which to start, and in this case we have  $c'o = 10$  inches, and the magnification

$$\text{equals } \frac{10}{c'o}.$$

Now, this point  $o$  possessing the foregoing properties is the point which, for want of a better name, is here designated the optical centre of the objective. It is near, but does not coincide with the point answering the definition in the text-books.

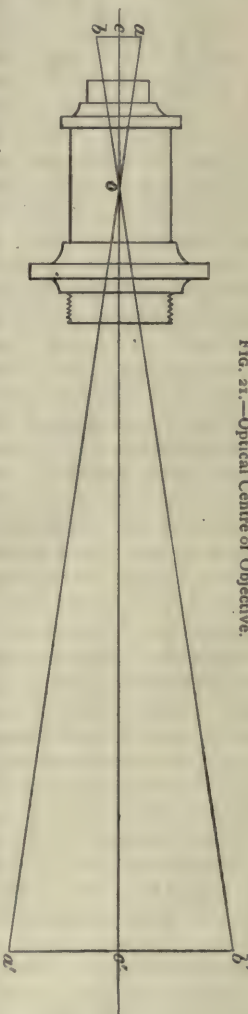


FIG. 21.—Optical Centre of Objective.

If  $co$  can be determined, and from that the distance from  $c$  to the front of the objective (the working distance) be taken,  $o$  will be determined with reference to the front of the objective and its position definitely fixed. Now to find  $co$  we recur to the equation above.

$$\frac{a'b'}{ab} = \frac{c'o}{co}$$

and by adding one to each side we have—

$$\begin{aligned} \frac{a'b'}{ab} + 1 &= \frac{c'o}{co} + 1; \\ \text{or, } \frac{a'b' + ab}{ab} &= \frac{c'o + co}{co} = \frac{cc'}{co}; \\ \text{or, } co &= \frac{cc' \times ab}{a'b' + ab}. \end{aligned}$$

Now,  $cc'$ ,  $ab$ , and  $a'b'$  are quantities which may practically be measured, and thus a definite value of  $co$  is obtained, and from that  $o$  is fixed.

Now, theory leads us to expect what experiment bears out, viz., that as the position of  $ab$  varies, and with it that of  $a'b'$ , the point  $o$  does not remain quite stationary. In some objectives it moves slowly back as the object is approached to the objective; and in others slightly nearer the front. But since we wish to have  $o$  determined when  $c'o = 10$  inches, that calls for one definite, fixed position of  $ab$ , and for a fixed value of the distance  $co$ . But  $co$  cannot be fixed unless both  $c$  and  $o$  be known; that is, unless  $o$  be already known. It would, then, appear that the problem is impossible since it calls for the result as a necessary condition to the solution. This is true, strictly speaking, but, practically, as close an approximation as may be desired is readily attainable.

The change in  $o$  for a change of an inch or two in  $a'b'$  will be probably less than the one hundredth of an inch, so that if the lengths be so adjusted that  $cc'$  equals about 10 inches plus the focal length of the objective, the distance  $c'o$  will come out differing from 10 inches by less than an inch, and, probably, by less than a tenth of

an inch, and  $o$  will be as accurately determined as ordinary measurements are made. If, however, greater accuracy is desired, the lengths may be readjusted so that from the determined position of  $o$  to  $c'$  shall be 10 inches. Then, making the measurements again, a new value is found for  $co$ , which will differ slightly from the first one, and be a still closer approximation. The position of  $o$  found from this value of  $co$  will differ from its true position when  $c'o$  is 10 inches, by less than one thousandth of an inch, probably, which is far within the limit of error in such measurements.

So much for the theory. In the practical application, a stage micrometer is placed in position, and one of its divisions serves for  $ab$ . The eye-piece is removed, the tube placed vertical, and a screen of ground glass or thin oiled paper is placed over the end of the tube on which to receive the image  $a'b'$ .

Let us suppose that the objective to be measured is one rated as a  $\frac{3}{4}$ -inch; then bring roughly to a focus, and next adjust the draw-tube until the distance from micrometer to screen is  $10\frac{3}{4}$  inches within, say, an eighth or a tenth of an inch. Then focus carefully until the lines are distinctly defined on the screen. Then measure the distance from the micrometer to the screen or  $cc'$ . This is found, we will suppose, to be 10.84 inches. Next, measure the value of a division on the screen. To do this as accurately as possible, measure the length of as many divisions as can be seen, and divide by the number. This will divide, by the same number, the error in making the single measurement. This gives  $a'b'$ , which in the case we have supposed equals .1125 inch. The value of  $ab$ , that is, of a division on the micrometer, is .01 inch.

Hence we have, making the proper substitutions,

$$co = \frac{10.84 \times .01}{.1125} = .885 - .$$

Taking this from 10.84 we find  $c'o = 9.925 +$ . Next, measuring the work-



ing distance, it is found to be .295. Taking this from .885 gives .59 as the distance of  $o$  back of the front of the objective. This position corresponds to a value of  $c'o = 9.925$  inches, which differs from 10 by .075 inch. Now, if greater accuracy is desired, readjust the draw-tube so that the screen shall be at 10.59 inches from the front of the objective; that is, at 10 inches from the determined position of  $o$ . Now, repeating the measurements, we find  $cc' = 10.883$  and  $a'b' = .113$ ;

$$\text{hence, } c'o = \frac{10.883 \times .01}{.123} = .8848,$$

$$\text{and } c'o = 10.883 - .8848 = 9.9982.$$

This differs from 10 inches by .0018—a quantity unappreciable in such measurements. Taking again the working distance, we find it to be .293 inch, which, taken from  $c'o$ , gives .5918 inch as the corrected distance of  $o$  from the front of the objective. This may safely be taken as the desired position, correct within the usual observational error in such work. As may readily be seen, an attempt at a recorection of this might be made in the same way that this was corrected from the first; but the errors of observation would probably be greater than the proper correction, so that such observations would possess no additional weight.

The magnification, as above stated, equals  $\frac{10}{c'o}$ , equals, in this case,  $\frac{10}{.8848} = 11.3$ , though this has been found previously by the actual measurement of  $a'b'$  compared with  $ab$ .

It may be of interest to compare this result with those derived from some of the other formulæ in use as approximations. First, there is the common rule, 'Divide 10 inches by the focal length of the objective' or  $\frac{10}{f} = 13\frac{1}{4}$ . This rule assumes that the objective is exactly à  $\frac{1}{4}$ , and that the object is placed at the principal focal distance from the centre, in order to form an image at 10 inches dis-

tance. The first assumption may or may not be true, as objectives often differ considerably from their rated values. The second is inaccurate, as the distance is always greater than the principal focal distance.

Next, there is the formula  $m = \frac{10-f}{f}$ ,

$$\text{or, in this case, } m = \frac{10 - \frac{3}{4}}{\frac{3}{4}} = 12\frac{1}{3}.$$

This assumes the rating of the objective to be correct, and makes use of the formula  $\frac{1}{f} + \frac{1}{f'} = \frac{1}{r}$ , which is only approximately correct.

Another method proposed is to measure the distance 10 inches from the front of the objective, and then to measure by a screen the magnified divisions of the micrometer. Performing these operations, we find in this case  $m = 10.55$ . This method will always give a result too small, and varying with objectives of the same focal length coming from different makers.

Next, as to the rating of the objective. This is usually defined as the principal focal length of a simple lens, which, under the same circumstances, would produce the same magnification. That is, it is the principal focal length of a double convex lens of equal curvature on each face, such that if substituted for the objective, and so placed that the distance from the image to the centre of the lens is the same as that between the image and optical centre of the objective, the magnification will be the same as that produced by the objective. The principal focal length of such a simple lens depends, however, on four elements: 1st, the radius of curvature of the faces; 2d, the refractive index of the material of which it is made; 3d, the thickness of glass traversed by the ray; 4th, the distance from the principal optical axis to the parallel ray. Within the limits for ordinary glass lenses, however these elements may vary, the principal focal length is not far from

the radius of curvature, but only equal to it under special circumstances. If, then, a comparison with such a lens were necessary in order to find the rating of an objective, there would need to be established a standard to which the last three elements above should conform; the variation in such standard lenses being only in radius of curvature. Of course such a system of lenses is out of the question, and some other method is necessary. The principal focal length might be measured practically but for the trouble in carrying out some of the details. It would be the distance from the optical centre for parallel rays to the point where they are brought to a focus. The first we do not know exactly, and cannot find in the same way as its position for diverging rays. The second calls for personal judgment on just when parallel rays are at a focus, which will admit of a slight variation on either side of the true position. Furthermore, the short working distances of higher powers would prevent the spot of light from being readily observed.

The function of focal length in general is to determine magnifying power, and, for all purposes of comparison, it seems but natural and just to base the rating on magnifying power, and on that alone. Such being the case, opticians seem to have generally come to use for such purposes what is virtually a kind of hypothetical lens possessing such properties that the common formula  $\frac{1}{f} + \frac{1}{f'} = \frac{1}{r}$  holds exact-

ly for it. It may be said, in passing, that in such a lens the thickness of the material would be entirely unappreciable in comparison with its radius of curvature, and the index of refraction of the material would be 1.5.

Such being the hypothetical standard, the formula above holds exactly, and solving for  $f$  we have  $f = \frac{f' r}{f' - r}$ . If, now,  $f$  represents  $co$  in the figure

above,  $f'$  will represent  $c'o = 10$  inches. Therefore, we have

$$f = co = \frac{10 r}{10 - r}.$$

But magnification equals  $\frac{10}{co}$ ; and substituting for  $co$  its value we have  $\frac{10}{co} = m = \frac{10 - r}{r}$ , or  $m = \frac{10}{r} - 1$ ,

$$\text{or } m + 1 = \frac{10}{r}, \text{ or } r = \frac{10}{m + 1}.$$

That is, the principal focal length of such a hypothetical lens as would produce the same magnification as the objective under the same circumstances equals 10 divided by one plus the magnification of the objective; and this is taken as the rating. As seen, it depends entirely on magnification under a standard set of conditions, and cannot but be fair as a means of comparison between objectives of various powers from the same or different makers.

Applying this rule to the example above, we have

$$r = \frac{10}{11.3 + 1} = \frac{10}{12.3} = .812.$$

This objective, on this method of rating, then, would rather be called an eight-tenths than a three-quarters, and a variation from the true value as large or larger than this will often be found.

If the objective has collar adjustment the optical centre and equivalent focal length vary with the position of the collar, so that if an exact knowledge of them is desired for any given position of the collar the operations must be performed with it in such position.

An idea of the range of power is, of course, obtained by taking it at the uncovered and extreme covered points; and these, with one or two intermediate positions, would probably give a sufficiently extensive knowledge of the powers of the objective.

In closing, it may be well to notice that the above method of measurement provides a practical way of using the 10-inch tube length. This term



tube length is, perhaps, in itself open to objection, for it seems to indicate that the 10 inches must be measured from some point in the objective to some other point in or about the eye-piece or tube. A correct understanding of the matter would seem to indicate that the tube is of such a length that when the eye-piece is in position it brings to a proper focus for the eye the rays coming from the objective, which alone would form an image at 10 inches distance from its optical centre. In other words, standard conditions should mean that the objective is at such a distance from the object that, alone, it would form an image at the 10-inch distance from the optical centre; and the draw-tube so arranged that the eye-piece brings such rays to a proper focus for the eye.

To practically arrange the length to conform to these principles, take the tube in the position in which it was left after finishing the final measurements for the optical centre, and focus again carefully so that the image is clear on the screen. Then remove it and put in the eye-piece. If the object is clearly seen, no further adjustment is necessary. If not, hold firmly the coarse adjustment and adjust the draw-tube until the object is properly focussed. A mark on the tube or a note of the length drawn out fixes the position for this eye-piece. For another it will probably be somewhat different. Now, under such conditions, when the tube, carrying objective, eye-piece, and all, is focussed up and down in the usual way, the objects brought into view are at the same constant distance from the objective, so that their images by the objective alone would be formed at the constant standard distance of 10 inches from its optical centre.

These remarks of course apply principally to the higher powers not furnished with correction collar, where a constant set of conditions is very desirable. Light, thickness of cover, mounting medium, etc., of course constitute part of the condi-

tions under which an objective is used, but, supposing these constant, we are here only concerned with the relative positions of object, objective, and eye-piece. These may be more or less widely departed from by the expert microscopist in order to balance some other unusual conditions, such as an extra thick or extra thin cover glass, some peculiarity in eye-piece or mounting medium, &c. But, aside from these, it would seem desirable to have some general method of using an objective under constant conditions, so that the interpretation of its appearances being once understood, the same principles may be always applied in future cases.

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### Diatoms of the Gulf.

BY J. D. COX, LL. D., F. R. M. S.

Scientific students, and especially those who are interested in the investigation of the diatoms, will, we are sure, take pleasure in the narrative or the work done by a trio of enthusiastic students in Mobile. These gentlemen are Messrs. K. M. Cunningham, W. S. McNeill, and G. H. Taylor. Neither of them is a professional botanist, all have other employments to which their ordinary working hours must be given, yet they have laid the students of the diatoms under such obligation to them that a recognition of the value of labors such as theirs is no more than their just due. The last named of these gentlemen is a surgeon dentist; Captain McNeill, formerly of the Confederate army, is the recent commissioner of Alabama to the New Orleans Exposition, and Mr. Cunningham is engaged in railway business.

In the summer of 1878 Mr. Cunningham accidentally became acquainted with Prof. Bailey's papers upon the Atlantic and Gulf diatoms in the Smithsonian 'Contributions,' and a zeal for research was thus awakened. He began a somewhat systematic examination of the region about Mobile for crude diatomaceous material, both

fossil and recent, and by exchanges collected a largely extended variety of material for work. He also made some investigation of the mud of Mobile harbor, but his first gatherings were not promising.

After a time, however, his patience was rewarded by the arrival of a vessel from Tampa bay, and upon its chain cables a considerable quantity of the Tampa bay mud was found. Joined at this time by Captain McNeill, both supplied themselves with the material, and Captain McNeill especially applied himself to the task of cleaning it and of studying the best methods of treating it. To this he devoted great patience and labor, with ultimate complete success. Mr. Cunningham continued to devote himself more particularly to the search for crude material in different directions.

Dr. Taylor early joined the two others, and devoted himself to the search for diatomaceous material in Mobile harbor, afterwards extending his researches to other harbors of the Gulf. His methods are presented in a paper published in this number of the JOURNAL, and will be found to contain many points of interest and some of decided novelty. His reliance upon thoroughly 'water-washing' his material, and 'sanding,' *i. e.*, taking the sand out of it, are lessons of experience of a very valuable kind. Even the most valuable muds were found very unpromising at first, and no German laboratory worker could excel in patience the persistent and careful manipulations to which Dr. Taylor resorted. To eliminate from the material everything which water alone would dissolve or hold in prolonged suspension was the first principle. It was followed out in almost innumerable washings, one following the other in indefatigable succession. The washing water was in large quantities, and the process pushed till his experience taught him that nothing more could be accomplished in that way.

Then came the 'sanding,' a pro-

cess not new in itself, but applied with new and peculiar persistence. The material, in a shallow dish, being agitated gently and with a circular motion, the sand accumulates in a little heap, and the diatoms, in a watery cloud, can be tilted away from the coarser material, and drawn off with bulb pipettes or similar instruments.

The secret is to do this again and again until the separation is really complete. The result is not simply to prepare the material for the final acid cleaning. It is worth the trouble for this purpose, but it has the further and greater advantage of furnishing material so 'water-washed' and concentrated that it is prepared for easy and satisfactory study before acids have touched it. No real student of the Diatomaceæ will fail to see that in this condition it is material of the greatest use and most profitable examination. Frustules are whole, filaments are complete, the tissues soluble in or destroyed by acids are left intact.

These Mobile investigators have pushed their examinations east and west along the Gulf coast. Their Pensacola material was communicated to Mr. Peticolas, of Richmond, and is put by him within the reach of students generally. They early shared their treasures with numerous naturalists of the country, among others with Mr. Mallory, of Utica, and Mr. Van Brunt, of New York. They cannot, of course, answer all the calls that may be made upon them, but we hope they may be induced to take steps which will put their prepared material within the reach of those who will see that an ample supply of slides may be easily attainable. As to the special steps found useful in the acid cleaning, Dr. Taylor's paper speaks for itself, and will be found worthy of a careful reading. He found the need of modifying so many of the steps commonly prescribed in our treatises on the subject, and so patiently and carefully worked out every experiment of his own to successful results that the



record of his work is valuable not only for its perfected methods, but as an example of indomitable will and patience in investigation.

During the present season he has cleaned a considerable quantity of new material, and has generously arranged to put it in the hands of Mr. Vorce to add to the interest of the 'working session' of the American Society of Microscopists at the Cleveland meeting, and to supply members with samples.

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### Cleaning Marine Muds.

BY DR. GEO. H. TAYLOR.

Let us suppose the material comes to us from anchors of vessels in hard, dry lumps. The first step is to disintegrate these lumps in water. My method is to place a lump in a bucket or large basin of water, and let it remain for several days, until it is soft enough to break up with the fingers. I then place the material in a dish, fill with water, and thoroughly stir the whole, then allow it to settle for fifteen minutes, and pour off the top. I repeat this until the top water becomes clear. If this is thoroughly done it will consume the best part of a week. The next step is to place the whole mass in a shallow dish or pan, fill it with water, stir the mass up thoroughly, and pour off the top into another vessel, repeating this process until nothing remains but the sand and mollusc shells. This is thrown away and the material poured back again into the shallow dish and 'sanded' as before. This process is repeated until there is no longer a deposit of sand, then place the material in an evaporating dish, cover with water, and with a movement of the arm in a circle revolve the dish gently, when the sand will ball up in the centre of the dish. Pour off the top, and throw away the sand. Repeat this operation until satisfied all the heavy sand has been removed. The material is now ready for the acid, but before applying acid it must be dried. To

obtain the best results, the best method is to let the water evaporate in the sun.

When the evaporation has taken place, transfer the material to a porcelain dish, pour nitric acid in with a free hand, and boil thoroughly, until all fuming has ceased; allow to cool, and wash thoroughly; again dry, and cover thoroughly with sulphuric acid, and boil until the fumes cease, then throw in pulverized bichromate of potash, little at a time, until the color changes; boil in sulphuric acid about ten minutes. Allow the material to cool thoroughly and pour into a large vessel of pure water, allowing it to settle thoroughly before drawing off the top water—about ten or fifteen minutes; repeat this washing until all traces of the acid are removed; when this is accomplished, the former process of sanding must be repeated. Keep this up until satisfied nothing more can be done in this way. The next step is to place the material in the porcelain boiling dish, add water until the dish is about two-thirds full, place over the fire, and, just before the boiling point is reached, throw in a stick of caustic potash about half an inch long, and let it boil thoroughly for four or five minutes, stirring from time to time. Pour this while hot into a large glass vessel, and let it settle for about one or two minutes—the appearance will determine the length of time necessary; draw off the top portion carefully and throw it away; the remainder must now be placed in a small bottle filled two-thirds with water, cork the bottle tightly, and shake vigorously, allow to settle ten minutes, then draw off the water; continue this process two days; then sand again by the rotary movement in the evaporating dish.

There must now be procured from a photographer two of the glasses used by them for embossed pictures, one large and one small, also from any drug-store one or two drop-tubes, with rubber bulbs. Now pour a little of the material upon the large

glass, and gently move it from side to side, which will cause the sand to settle; slant the glass toward one corner, and draw off with the pipette and place in the bottle; add more water to the glass and draw off as before, until nothing but sand and spicules remain; repeat this process five or six times with the small glass. The material is now placed in the shaking bottle, and a few drops of ammonia added. Shake vigorously two or three minutes, allow to settle, draw off carefully, and repeat this process ten times. Sand again by means of the embossing glasses, and the work is finished.

In this work everything depends on the thoroughness of the sanding and the faithful manner in which the shaking is performed. The shaking is, next to sanding, the most important part.

In regard to the acid treatment, I may say that good results can be produced by either nitric, sulphuric, or muriatic acid, but muriatic acid should never be poured into sulphuric without great caution, for it will boil over. Muriatic acid by itself produces good results. So also does nitric acid, but I have found the best results are obtained by the use of the nitric acid, followed by the sulphuric. It does no harm to boil again in nitric; this must be done if the sulphuric acid is not thoroughly washed out, otherwise crystals would form on the glass.

The best stand I have ever seen for holding the boiling dish is a tin-can procured from any drug-store, with a tin top; it is about ten inches high by about six inches broad. Cut a hole through the top to fit the dish, then cut a door large enough for the lamp to be placed through, one or two air holes near the top, and it is ready for work.

I use a dentist's chip-blower to draw the water out of my shaking bottle, and would advise others to do the same, as it saves many valuable forms from being poured off when decant-

ing. My shaking bottles are about four-ounce vials, or vials that the tube of the chip-blower will easily reach the bottom.

In regard to my experience with Mobile Bay mud, I will only say that I took soundings every half mile for twelve miles in one way, and for thirty miles in another, and obtained samples of mud from any and every point I possibly could. I worked for more than a year before I found any forms except those that were worthless. My first find was from a dredge boat, seventeen and a half miles from the city. I had only a small hand full of this material. So I eagerly sought for more, but, alas! the dredge sank during a gale, and I was unable to procure any more for months. I next found good forms in mud from the bay one half mile from Fort Morgan. Again I obtained fine results from Lower Dog River Bar; I obtained this material by means of a tug-boat. I found a few good forms in Heron Bay, a small bay which makes into an island situated in Mobile Bay. The Pensacola material was procured for me by means of a row-boat, about one mile from Pensacola.

I do not like to speak of my trials and failures in working Mobile Bay muds, because when I look back upon them I am almost tempted to disbelieve myself. Suffice it to say I spent eighteen months on this one deposit without reward. Many a night have I sat up watching my bottles, which were placed between two lamps on the chimney-piece. I can remember my delight when, after a week's work, I would discover a single form, perhaps two, surrounded by a mass of sand; and such sand! I dreamt about that sand, fought with it, but for eighteen months it was my master. This long work, without success, taught me the lesson of patience, and finally resulted in my success. I declared war against the sand and tried to master it by watching the settlements, but in vain, until I adopted the plan



of fighting it from the moment the raw material came into my hands; then, and not till then, did I receive my reward. To give an idea of how poor the material is in its original condition, I will state that the amount contained in a homeopathic vial a quarter of an inch deep cannot be procured from less than one quart of the raw material.

### Fasoldt's Detaching Nose-Piece.

The device of Mr. Charles Fasoldt for rapidly changing objectives, which is illustrated in Fig. 22, has already become very popular. It is an ingenious device, and it is said to be quite accurate in centring the lens. The method of operating it is easily understood from the figure. As will be seen, the device screws into the nose-piece of the microscope, and is adjusted in any desired position by means of a collar provided for the purpose. The objective is held securely by a spring working against the lever. The society-screw in the nose-piece is in three segments—one on the movable piece connected with the lever, the other two on the opposite side of the nose-piece. The objective should be marked so that it can always be put in with the screw-thread in the right position. The maker gives the following instructions for using the device:—‘Take the ob-

jective in the right hand, between the first and second fingers, as represented in the cut, place it in the nose-piece, then let go the lever with left-hand finger, and turn the objective to its resting place. The objective should be turned back one-eighth of a turn, and a black mark made on it, which should stand between the fingers as a guide, when the objective is put into nose-piece. Then it will invariably require only one-eighth of a turn to bring it home.’

If the objective is put in just right it will not require to be turned.

This nose-piece has been very

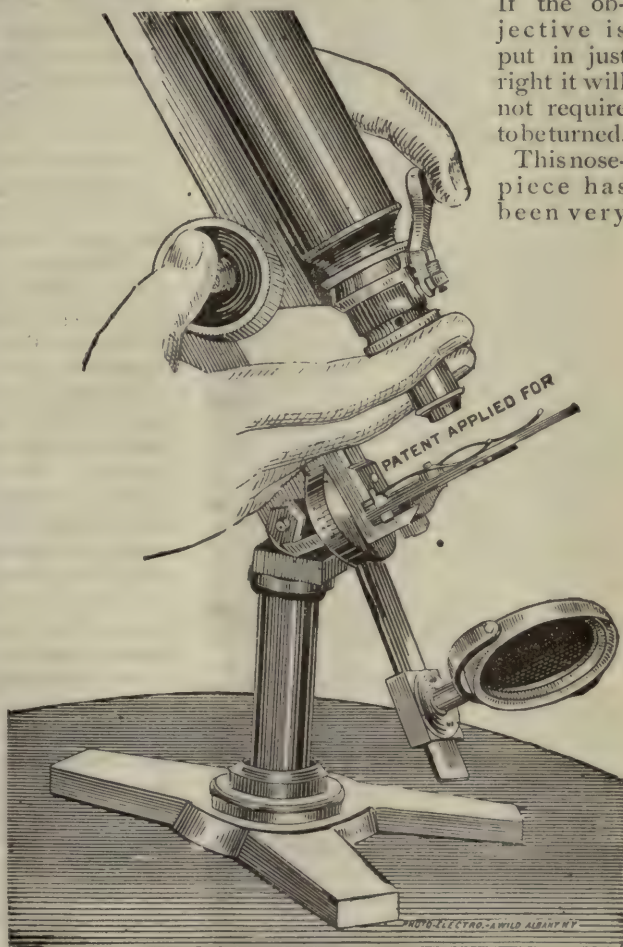


FIG. 22.—Fasoldt's Detaching Nose-piece.

highly spoken of by those who have used it. We have given it a trial and

can commend it, for convenience and rapidity of action, in the highest terms.

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### Measurement of Blood Corpuscles.\*

For some time past I have been endeavoring, for my own satisfaction, to determine whether there is a constant average size of the human red blood corpuscles, with the view ultimately to determine whether it is possible, by means of micrometric measurements, to distinguish human blood from the blood of domestic animals.

In order that the results arrived at may be compared with those of other observers, I think it proper to state at the outset the methods and instruments employed.

The first requisite is obviously a correct standard of length, and the accurate determination of the value of the eye-piece micrometer used. This preliminary work has engaged much of my time and attention for several months past, and I have finally succeeded in obtaining two very accurate standards. The one of these which has been used as the standard of the measurements hereinafter given consists of lines ruled by Prof. W. A. Rogers, of Cambridge, Massachusetts (who is recognized as the highest authority upon questions of this sort), upon speculum metal at intervals of 1-2000 inch. The relative and absolute corrections of this standard have been determined by Prof. Rogers with very great accuracy, and the value of a division of the eye-piece micrometer described below was determined by taking an arithmetical mean of a long series of measurements of different intervals of 1-2000 inch, so as to eliminate as nearly as possible all errors of graduation and of measurement, and the value of one division of the micrometer was thus found to be .0000009925 or, approximately, 1-1000000 inch. The stand used, with mechanical stage and Abbe condenser, was made by Mr. Walter

H. Bulloch, of this city, and is of the pattern styled by him the 'biological stand.'

The actual tube length was 8.91 inches from end of nose-piece to upper end of draw-tube.

The cob-web eye-piece micrometer used was also made by Mr. Bulloch, the pitch of the screw being  $\frac{1}{2}$  millimeter, and the micrometer head being divided into 200 parts, which were read to 1-10 of a division.

The objective used was a homogeneous immersion 1-10, made by H. R. Spencer, of Geneva, N. Y., having a numerical aperture of 1.35, and it was used with a Bausch & Lomb achromatic amplifier, giving an amplification of about 1,500 diameters. The immersion fluid used was Prof. Smith's new homogeneous immersion fluid, the composition of which he has not yet made public.

The blood was drawn from my finger, and a thin film spread with a needle upon the side of a cover-glass from .150 to .165 of a millimeter in thickness, and examined at once, a fresh sample being used upon each occasion. It was examined with central illumination, and always under as nearly the same conditions as possible. During the first four days of the examination, I took, night and morning, about one drachm of the elixir of calisaya, iron, and strychnia; during the rest of the time no drug was taken, and the conditions were nearly identical each evening. From 25 to 100 corpuscles were examined each evening, and I have tabulated the results, giving the smallest, largest, and average size, in millionths of an inch, of each 25 corpuscles; also the average of each 50, 75, 100, and 200 corpuscles. The corpuscles were measured, large and small, as they presented themselves in the field of the microscope, the only condition being that they should be approximately circular.

[The tabular statement of results is omitted, as the summary given below is quite sufficient.—Ed.]

\* From advance proofs of the *Chicago Legal News*.



An examination of the above figures shows that the difference between the greatest and smallest averages of 25 corpuscles is .000028 or 1-35714 inch, a magnitude that may be easily measured by any person having the requisite skill and apparatus.

The difference between the highest and lowest averages of 50 corpuscles is .000015 or 1-66666 inch, which approaches more nearly the limit of micrometric measurement, though probably not beyond it.

The difference between the highest and lowest averages of 75 corpuscles is .000012 or 1-83333 inch, which approximates the limit of micrometric measurement.

The difference between the highest and lowest averages of 100 corpuscles is .000009 or 1-111111 inch, which is within the limits of personal and instrumental error, according to the highest living authority upon this subject, who writes, in substance, that it is easy to measure 1-50000 inch, but to be sure of 1-100000 inch is not possible.

The conclusion to be deduced from the above figures is obviously that, when a sufficient number of corpuscles are measured, there appears to be an average size which varies within very narrow limits, which may possibly be accounted for or at least is consistent with personal and instrumental errors; for though I have carried out the figures to the sixth decimal place, I have not the presumption to declare that the results can be relied upon farther than the fifth place, and have carried out the figures to the sixth only to insure accuracy in the fifth so far as possible. Another conclusion is, that granting for the moment that it is possible to identify blood by measurements of the red corpuscles, of which I am by no means satisfied, it is reckless in the last degree, if not criminal, to express an opinion upon the measurement of less than 100 corpuscles. To express an opinion upon the measure-

ment of only 10 corpuscles, as I am informed has been done in this section within the last year or two, to take the most charitable view of the subject, betrays such culpable ignorance of a subject involving such momentous consequences as ought forever to invalidate the testimony of one who should swear so recklessly. In a case involving the issue of life and death it would be better to measure several hundred corpuscles.

An examination of the unabridged table of measurements, from which the above summary is tabulated, discloses the further fact, that by selecting the corpuscles it would be possible for a dishonest observer to make the average much larger or smaller than that above given, without the possibility of detection; a fact, the bearing of which upon the value of expert testimony upon this subject is so obvious as to need no comment.

It will be seen that I have not attempted to draw any inference as to the cause of the larger average size of the corpuscles first measured. Whether it was or not due to the drugs exhibited during the beginning of this work, is an interesting subject of inquiry, which must be reserved for future examination. I expect to continue these investigations, and at some future day will publish the results.

MARSHALL D. EWELL, M. D.

CHICAGO, July 22, 1885.

### Conjugation of *Rhabdonema*.

In a late number of the *Journal* of the Quekett Microscopical Club Mr. T. H. Buffam has described some newly-observed phenomena in the conjugation of the diatom *Rhabdonema arcuatum*, that are of great interest. It is not possible to do full justice to the subject without the plate, but an account of the phenomena observed may prove of interest to the reader.

The diatom grows in ribbon-like filaments on marine algæ, the breadth varying from three to nine times the

thickness. The author distinguishes the male and female frustules by their size and manner of growth, the former being small (.00156 inch in length), delicate, with a relatively small amount of endochrome, which is arranged about the nucleus in a roughly stellate manner. These frustules, attached by their corners, grow in a zigzag chain.

The female frustules are but slightly larger (.00188 inch), but are distinguished by numerous annuli and a large hoop in the middle.

In conjugation the male frustules attach themselves to the female, at or near the free end of a filament; usually four males are found on one female, but as many as eight have been observed. It would appear that the male filament breaks up and the individual frustules make their way to the female, and there attach themselves by their corners.

It now appears that the terminal half of the female frustule falls away, leaving the cell open. A gelatinous secretion closes it again. In some way, not very clearly explained in the article, the contents of the male frustule pass into the female cell. Being thus fertilized, the contents become surrounded with a thick, gelatinous secretion and form a large sporangium outside of the frustule. Either one or two sporangia may be formed from a single frustule. It is suggested that if the nucleus has divided just before fertilization there will be two sporangia, otherwise only one.

Within the clear sporangium a new frustule is produced, about three times the length of the original female cell.

The conjugation of diatoms is a process deserving of very careful study, and there is no field of observation open to the general student of microscopic life that promises better opportunities for new discoveries of importance. The subject is still very imperfectly understood. If the many who spend their time in detecting slight differences in form and mark-

ings of the frustules, thereby discriminating ephemeral species, and adding to the already almost inextricable confusion in the classification of the diatoms, would devote their spare moments to the study of the phenomena of the life, growth, and reproduction of these organisms, the results would be of great value to science. Will not some of our readers who are looking for a field of original work take up this subject in earnest? The specimens can be collected, preserved, and mounted, and then studied at leisure.

#### Staining Tissues in Microscopy.\* IV.

BY PROF. HANS GIERKE.

[Continued from p. 133.]

ANILIN DYES.

71. Beneke. *Correspl. d. Vereins f. gemeinschaftl. Arbeiten*, 1862. No. 59, p. 980.

Recommends dissolving commercial lilac anilin in acetic acid, which gives a clear solution.

72. Waldeyer. (See No. 36.) *Untersuchungen u. s. w. in Henle u. Pfeufer's Zeitschr.* 3 Reihe, Bd. xx, p. 200. 1863.

Describes a course of experiments with anilin dyes, especially red, violet, and Paris blue. The red is particularly commended. A strong solution contains, in 50 c. c. of water, 15 drops commercial anilin red, a weaker has 250-300 c. c. more water. This dye stains more quickly than ammoniacal carmine. It will even color in an instant under the cover-glass. But the preparations darken and are not permanent. Nuclei take the color more readily than protoplasm, and the axis cylinder more readily than the medullary substance of nerves.

73. Onimus. *De l'emploi de la fuchsin dans l'étude des éléments anatomiques.* *Jour. de l'Anat.*, 1865. No. v, p. 569.

Recommends fuchsin as a stain.

\*From the *Zeitschrift für wissenschaftliche Mikroskopie*. Translated for this JOURNAL by Prof. Wm. H. Seaman, M. D.



74. Frey. (See No. 38.) Die Hema-  
toxylinfärbung. Arch. Mikr.  
Anat. Bd. iv, p. 345. 1868.  
Recommends 'Parma,'  $\frac{1}{10}\%$ .

75. v. Ebener. Ueber den Bau der  
Aortenwandung, besonders der  
Muskelhaut derselben. Rol-  
let's Unters. a. d. Inst. f. Phys.  
u. Hist. in Graz. Leipzig,  
1870, p. 32.

Stains the walls of the blood ves-  
sels with anilin red, and finds elastic  
tissue colors well.

76. Merkel. Zur Kenntniss der  
Stäbchenschicht der Retina.  
Arch. f. Anat. u. Phys. 1870,  
p. 642.

The structureless skin of the retina  
is finely brought out by anilin red,  
even after treatment by perosmic acid.

77. Zuppinger. Eine Methode Ax-  
encylinderfortsätze der Gang-  
lionzellen des Rückenmarks  
zu demonstrieren. Arch. f.  
path. Anat. Bd. x, p. 255, ff.  
1873.

Cross-sections of spinal marrow are  
stained by anilin blue rendered solu-  
ble in water by a little acetic or hy-  
drochloric acid.

78. W. Hatchelt Jackson. On stain-  
ing sections with Magenta.  
Quart. Journ. Micr. Science.  
1874, p. 139.

For permanent preparations the fol-  
lowing dye is recommended:—To a  
dilute watery solution of rosanilin add  
by drops tannic acid till all the color  
is precipitated (a slight residue will  
always remain). Wash and dry the  
precipitate, and dissolve in alcohol  
with a few drops of acetic acid. The  
preparations should not be mounted  
in glycerin or balsam, but in sugar  
syrup, to which 3 to 4% of sodium or  
calcium chloride has been added.

79. Huguenin. In Correspbl. f.  
Schweizer Aerzte. 1874. No.  
10.

Dahlia is warmly recommended  
for bring out the axis cylinders of  
nerves, but no details are given.

80. Fischer. Eosin als Tinctions-  
mittel f. Mikroskopische Prä-  
parate. Arch. f. Mikr. Anat.  
Bd. xii, p. 349.

Eosin, the potassium salt of tetra-  
bromfluorescein, is red with green fluo-  
rescence, and dyes sections in water  
in 10–12 hours. It is better to pre-  
cipitate it by acids, filter, and dissolve  
in alcohol, 1–20 or 30. May be used  
on objects treated by Müller's fluid,  
and on fresh specimens, which are by  
it hardened and stained at the same  
time. Epithelium, muscular fibre,  
axis cylinders and blood vessels stain  
of a beautiful red, connective tissue  
and nerve cells less readily, and the  
medullary matter not at all. The  
amyloid substance of degraded or-  
gans stains deeply.

81. Lawson Tait. On the freezing  
process for section cutting,  
and on various methods of  
staining and mounting sections.  
Journ. of Anat. and Phys.,  
vol. ix, p. 250–258.

Mr. Tait condemns all the anilins  
as well as carmine. (See No. 60.)

82. Heschl. Eine hübsche à vista  
Reaction auf amyloid-degene-  
rirte Gewebe. Wiener med.  
Wochenschr. No. 32, p. 714.

Leonhardt's violet ink, which is  
only a mixture of blue and red ani-  
lins, stains amyloid portions of tissue  
a beautiful rose red, while the rest is  
made blue.

83. R. Jürgens. Eine Neue Reac-  
tion auf Amyloidkörper. Vir-  
chow's Arch. Bd. lxxv, p.  
189–195.

Jürgens recommends iodine violet  
in water for the same purpose as in  
82. Those parts showing amyloid  
degeneration stain a clear red, while  
the remainder appear violet blue. A  
little time is necessary to produce the  
best results, during which the colors  
deepen somewhat.

84. Ranvier. Des Préparations du  
tissu osseux avec le bleu d'ani-  
line insoluble dans l'eau et solu-  
ble dans l'alcool. Arch. des  
Physiol, 1875, pp. 16–21.

Sections of bone are stained by an anilin blue that is soluble in alcohol, not in water. The sections are slightly scraped with the scalpel, then put in a warm concentrated alcoholic solution of anilin blue on the water bath, where they remain till nearly dry. They are then rubbed on a fine stone, moistened with a 2% solution of salt, in which they are at length well washed, and finally sealed in a mixture of equal parts of the salt solution and glycerin.

85. Cornil. Sur la dissociation du violet de méthyl-aniline et sa séparation en deux couleurs sous l'influence de certaines tissus normaux et pathologiques, en particulier par les tissus en dégénérescence amyloïde. *Comptes Rendus*, 27 Mai 1875.

An aqueous solution of violet methylanilin is recommended. A special advantage is, that many tissues are finely differentiated by the separation into blue violet and red shades which takes place. In hyaline cartilage, for example, the fundamental tissue becomes red, the cells and their capsules violet, likewise the fibrillæ of connective and elastic tissue and the fibres of elastic cartilage. The stain is unfortunately not permanent. In ordinary mediums, as glycerin, balsam, turpentine, oil of cloves, and alcohol, it is soon extracted from the preparation. Amyloid degenerations hold the methyl violet much better. They appear of a reddish violet, while the healthy elements dye blue; they may be kept in glycerin. On treatment by acetic acid the red color of the degenerate tissues is more permanent than the blue of the healthy parts.

86. Hermann. Ueber eine neue Tinctionsmethode. *Tagebl. d. 48 Naturfvers. Graz*, 1875. p. 105.

Sections stained with fuchsin are soaked in alcohol till no more color is extracted. The nuclei only retain the dye; the surrounding pale color is

much altered. Anilin colors soluble in alcohol, and obtained from rosanilin only, are used, especially fuchsin, which is known in commerce as ruby red. The material should be hardened in alcohol and may be first treated with chromic acid. A good dye is made by adding 0.25 gm. ruby fuchsin to 20 c. c. alcohol of 96% and about 20 c. c. water. The mounts may be of the ordinary kind.

87. Wissowzky. Ueber das Eosin als Reagenz auf Hämoglobin, und die Bildung von Blutgefässern und Blutkörperchen bei Säugethier- und Hühnerembryonen. *Arch. f. Mikrosk. Anat. Bd. xii*, pp. 479-496. 1876.

Eosin and alum, each one part, are dissolved in 200 parts of alcohol as a reagent for hæmoglobin, with which it unites in the red blood discs and colors them orange red. The nuclei and stroma of the blood discs deprived of their hæmoglobin are no more affected by the dye than the white blood corpuscles.

88. Lavdowsky. Zur feineren Anatomie und Physiologie der Speicheldrüsen insbesondere der Orbitaldrüsen. *Arch. Mikr. Anat. Bd. xiii*, pp. 359-362.

An ammoniacal solution of eosin is preferred to one made with water or alcohol. It should be very slightly alkaline or neutral and so dilute as to barely show color. In this the sections lay for 24 hours, and are then exposed to the vapor of acetic acid. This solution stains the lining cells of the stomach red, leaving the basal tissue colorless, but in the peptic glands there is little differentiation. Lavdowsky also made a mixture of picric acid and eosin by adding to an ammoniacal solution of the latter some time made, picric acid till neutralized; this mixture he called *microeosin*.

89. Dreschfeld. Ueber eine neue Tinctionsflüssigkeit für histologische Zwecke. *Med. Centralbl. 1876. No. 40*. On a new staining fluid. *Jour.*



Anat. and Phys., vol. xi, p. 181-182.

Sections of hardened material are stained by a watery solution of eosin, 1-1000 or 1500 distilled water. Treatment by absolute alcohol extracts the dye from fresh sections. When laid in the above stain for a minute or a minute and a half, they are put in very dilute acetic acid for a few seconds. Eosin is particularly useful for investigations of nervous tissue, for the nuclei and nucleoli of ganglia, and the axis cylinder of nerves which dye red, while the medullary substance remains uncolored, and the connective tissue stains more deeply.

90. Treitel. Eine neue Reaction der Markhaltigen Nervenfasern. Med. Centralbl. 1876. No. 9, p. 147.

Treitel used several anilin dyes, including iodine-violet, fuchsin and anilin blue. He found normal medullary nerve matter stains deeply, while degenerate nerves stain feebly, and connective tissue not at all. Preparations treated by Müller's fluid stain well. One drop of a 1% solution to 1 c.c. of water stains sections in one minute. In this method the nucleus remains colorless, also the membrane of Schwann, the axis cylinder is slightly tinged. The continued action of concentrated solutions stains all parts.

91. Baumgarten. Knorpel, Knochen und Anilin farbstoffe. Med. Centralbl. 1876. No. 37, p. 657.

Examines the nature of ossification and cartilage by means of Leonhardt's ink, which is a solution of anilin violet. This is applied to portions of the epiphyses of immature bones treated with wood spirit. The sections lay in the dye 2-10 minutes, then in slightly acidulated water till a decided change from a blue to a violet shade occurs, and are then well washed. The cartilage will now be slightly blue or violet, that which is slightly calcified violet to rose and the formed bone slightly reddish or color-

less, while the marrow is blue. Similar results may be obtained by treating with fuchsin and washing in hydrogen chloride. In this case they must be washed in glycerin or absolute alcohol, not in water. The cartilage will then be reddish blue, that which is partly calcified clear blue, and formed bone red or colorless, and all nuclei carmine.

92. Ehrlich. P. Beiträge zur Kenntniss der anilin färbungen, und ihrer verwendung in der Mikroskopischen Technik. Arch. Mikr. Anat. Bd. xiii, pp. 263-277.

Dahlia is monophenylrosanilin, and is closely allied to parma blue, which is diphenylrosanilin, and anilin blue which is triphenylrosanilin. Most of it is only soluble in alcohol, but a variety soluble in water occurs. A reddish shade is usually preferred. In a neutral aqueous solution animal tissues take an intense color, amyloid substances red, and protoplasm bluish violet. Nuclei stain but little or not at all. Treated with very dilute acetic acid the protoplasm and connective tissue bleaches, the nucleus becomes a bluish violet. The 'plasma cells' of Waldeyer stain and do not bleach, not even after long treatment by absolute alcohol. To stain these cells only, harden in absolute alcohol, and treat with absolute alcohol 50, distilled water 100, glacial acetic acid, 12½ dahlia till saturated. Leave sections in dye for 12 hours, dehydrate, mount in balsam. Sometimes mucin cells will stain, also rarely the fat of fat cells.

Some other anilin colors dye plasma cells. They are all soluble in water, and are used with 7½ pts. glacial acetic acid and 150 parts 40% alcohol and as much dyestuff as will dissolve. The following have been used: primula, iodine violet, methyl violet, purpurin, safranin and fuchsin dahlia; and the first four stain plasma cells, only the rest remaining colorless, while the last two merely color the plasma cells more darkly. Ranvier's

chinolin blue and weak alcoholic solution of cyanin, when used with alkaline glycerin, make them a fine red, while protoplasm stains blue and fat bluish. The intensity of the dye depends on the granules scattered through the protoplasm. The nuclei of the plasma cells remain colorless. The granules are certainly not molecularly fat. They consist of a material having the following characters, viz., it is insoluble in water, alcohol and ether, and not attacked by alkalis, and does not readily decay. Further than this is unknown.

93. Sankey. On a new solution for staining sections of hardened animal tissues. *Quart. Jour. Micr. Sci.*, 1876, p. 35.

Sankey uses an English dye commercially known as anilin blue black, easily soluble in water, not very soluble in alcohol. To 1-2 cc. water add 0.5 gm. of the dye, and 99 cc. alcohol. This will stain in a few moments, and shows the nuclei better than carmine. Excellent for the large nerves.

94. Bevan, Lewis. Preparation of sections of cerebral and cerebellar cortex for microscopic examination. *Quart. Journ. of Micr. Sci.*, 1876, p. 69. *Med. Times and Gaz.* 1876, Mar. 4.

Warmly recommends Sankey's 'blue black' for nervous tissues and prefers it decidedly before carmine in aqueous solution of  $\frac{1}{2}$  to 1%. Especially does it bring out clearly the prolongations of the cells, which may be more clearly made out by washing after staining and exposure for 20-30 minutes to a solution of chloral hydrate.

(It will be found that success with anilin dyes depends very much on the quality of the article used. I have not succeeded in obtaining good results in nerve preparations with such dyes as are found in the German market. Treatment with chloral hydrate renders the sections unfit for preservation.)

95. Luys. Emploi d'une nouvelle matière noire dérivée de l'anilin (noir Colin), pour les préparations histologiques et les reproductions photographiques. *Gaz. Med. de Paris*, 1876. No. 29, p. 346.

Material hardened in chromic acid or chrome salts must be very carefully washed before treatment with this new microscopical dye called 'Colin's black.' The sections may lay 3-4 minutes in a  $\frac{1}{10}\%$  solution, and may then be mounted in the ordinary manner. They are especially adapted for photographic reproduction.

### Improved Microtome.

The use of paraffin for imbedding is attended with difficulties on account of its becoming loose in the microtome. I have made a microtome in which the difficulties are overcome. A hole was turned about half-way through the table of a microtome, and into this a tube was screwed, forming the well. The hole through the remainder of the table, forming the mouth of the well, was turned with sufficient 'gather,' or taper, to take up the shrinkage of the paraffin. On the upper side of the piston a dovetailed groove was turned. The column of paraffin receives no support from the tube, but is securely held by the piston at one end and by the contracted mouth of the well-hole at the other. The following dimensions may be of use if any one wishes to make a similar instrument: Diameter at the top, .9 inch, tapering from diameter of .92 inch. Length of taper, .15 inch.

F. H. GOWEN.

—Dr. R. V. Ledenfeld has recently described in *Zoologischer Anzeiger* some peculiar cells in certain Australian calcareous sponges which he regards as nerve-cells. The nervous system of sponges, when it consists of specially differentiated cells, is mesodermal. It is concluded that the calcareous sponges cannot longer be regarded as protozoic organisms.



## EDITORIAL.

**Publisher's Notices.**—All communications, remittances, exchanges, etc., should be addressed to the Editor, P. O. Box 630, Washington, D. C.

Remittances should be made by postal notes, money orders, or by money sent in registered letters. Drafts should be made payable in Washington, New York, Boston, or Philadelphia.

Subscription-price before April 1st, \$1 per year, in advance. All subscriptions begin with the January number. After April 1st the subscription-price will be \$1.50.

The regular receipt of the JOURNAL, which is issued on the 15th of each month, will be an acknowledgment of payment.

The first volume, 1880, is entirely out of print. The succeeding volumes will be sent by the publisher for the prices given below, which are net.

Vol. II (1881) complete, \$1.50.

Vol. III (1882) complete, \$2.00.

Vol. IV (1883) complete, \$1.50.

Vol. V (1884) complete, \$1.50.

Vol. V (1884), Nos. 2-12, \$1.00.

### MR. ZENTMAYER'S REMOVAL.—

Mr. Zentmayer has recently changed his place of business from the building on South Fourth street to No. 201 South Eleventh street, Philadelphia, where he has opened a store, with a factory for optical apparatus in connection with it. Hereafter he will carry a full line of spectacles and eyeglasses, in addition to microscopes and accessories. The change will no doubt be beneficial, and we wish Mr. Zentmayer the best of success in his new quarters. His business was established in 1853.

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**MEETINGS THIS MONTH.**—There will doubtless be a large attendance at the meetings of the American Association at Ann Arbor, and of the American Society of Microscopists at Cleveland this year. Especial efforts have been made to make the Cleveland meeting a brilliant one, and Mr. Vorce has exerted himself, as Chairman of the Soiree Committee, to get together the greatest display of objects ever yet seen. It is to be hoped he will be rewarded by perfect success.

At Ann Arbor a good attendance is anticipated. In addition to the regular meetings of the Association, the Botanical Club of the A. A. A. S. holds its meetings during the week of the Association, from August 26th to September 2d, at such times as an-

nounced on the daily programme. A good attendance of botanists is assured, and subjects of general interest will be considered. The Club offers an excellent opportunity for the presentation of short notes and observations, while the weightier matters can be brought before the general Association. Some excursions will be made especially for the botanists, and a thoroughly enjoyable time may be expected.

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**PROF. SMITH'S NEW MOUNTING MEDIUM.**—Some misunderstanding has been created by the fact that Prof. Hamilton Smith has not yet seen fit to make known the composition of his mounting medium of high refractive index. We are not at present authorized by Prof. Smith to make any statement concerning this matter, but from what we know, and have learned from conversation with Prof. Smith some time ago, we are assured that there are excellent reasons why the composition is still withheld from the public. It is probable that Prof. Smith is as yet not fully satisfied that he has discovered the best method of preparing the medium. He has experimented with various combinations for a long time, and many of them have seemed to be at first very satisfactory, but they have not stood the test of time. We have no doubt that the principal reason for withholding the composition of the fluids is that Prof. Smith is unwilling to make it public until he is fully satisfied that he has obtained a perfectly reliable medium, and can give full directions for using it. Being ourselves acquainted with some of the compounds experimented with, and the results obtained, we are free to say that Prof. Smith is not keeping the matter from the public for any insufficient or selfish reason—in fact, it is not a secret.

—o—

**SYNOPSIS OF DIATOMS.**—The text of this valuable work is now to be obtained, and is offered in our advertising columns. Although published

in French, it will be found, we believe, quite practicable for those who do not understand the language to use the work for the identification of species, since the words used in description are so nearly like the corresponding words in English.

The first part of the volume is taken up with a general account of the diatoms—their structure, processes of growth and multiplication, and the methods of studying, preparing, and mounting them in different media.

The arrangement of the systematic part is, so far as our limited knowledge of the subject enables us to judge, far superior to any other classification we have seen. The family is divided into three sub-families, Raphides, Pseudoraphides, and Crypto-raphides. The sub-families are then divided into tribes, genera, and species. In each case there is an analysis or synopsis of the tribes, genera, and species, arranged like the key of a botanical textbook, or like the synopses of genera of algæ in the 'Provisional Key to Algæ of Fresh Water,' now being published in this journal. The genera and species are clearly described, and references are given to original descriptions and figures.

We shall doubtless have occasion to refer to some parts of this work more at length in future. Hitherto we have regarded the study of diatoms, at least the determination of species if not also of genera, as something only possible after long study and familiarity with the various forms; principally because the subject has seemed involved in such hopeless confusion, with the valuable literature so extensive and scattered, and the synonymes confusing and almost endless. A careful examination of the text now published leads us to believe that Dr. Van Heurck has, by his masterly treatment of this very difficult subject, opened the way for the quick determination of any species described in his book.

We believe that the publication of this work marks an era in the study

of the diatoms, from which great advances in our knowledge of these interesting plants will begin. No student need longer be deterred by want of sufficient literature from undertaking their study, for in this work alone will be found all that is essential for the determination of nearly all the established species. Not all, to be sure, since it is devoted especially to the diatoms of Belgium; but it is still sufficiently comprehensive for use in any part of the world.

A naturalist not specially familiar with the diatoms can now study his own collections and compare the species with those found in other localities, as it has never before been possible.

Subscribers to the plates have all received notice by mail that the volume of text can be furnished on receipt of their orders. As only a limited number of copies has been received orders should be sent promptly, otherwise we may be obliged to hold them until a second importation is received.

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MICROSCOPICAL EXHIBITIONS.—The letter of a correspondent upon this subject, published in another column, brings forward probably the only valid arguments that can be urged against the suggestions that have led to his criticisms. Assuming that the proposed plan is practicable—which is a matter of uncertainty to us, except in exceptional cases—the subject seems worthy of further consideration, and we would invite a free interchange of opinions in our correspondence column from readers who are interested in it. Meanwhile, we avail ourselves of this opportunity to reply to our correspondent's objections, in order that the reader may have a clearer idea of the subject as it presents itself to us.

Our suggestions were made rather hastily, and, as was stated at the time, without sufficient consideration to enable us to present the details in a satisfactory manner. The subject,



however, has long been in mind, although not well thought out.

Our correspondent, whose name is withheld because his letter was not written for publication, asserts that the public does not want to be instructed, but amused. Perhaps so; but is it the proper function of a scientific society to amuse the public? It may be said, Yes, if thereby instruction can be imparted. However, we are not sure but something more than mere amusement is wanted by the public at microscopical exhibitions. Indeed we are inclined to believe the great attraction of a microscopical exhibition to most persons is the expectation of seeing beautiful and wonderful structures and organisms in the world of minute things. But it can hardly be true that the mere beauty of the specimens is the whole attraction, for the minute size of the objects, and the revelations of the perfection of Nature's smallest works, gives an additional interest to such exhibitions. There is, therefore, another element to be considered, which we have thus merely indicated, and it is only putting the matter in another form to say that the people who attend are really desirous of learning something. If the more brilliant and striking objects do attract most attention, it may be because they are more readily understood or appreciated. It would seem that before we reach a conclusion so uncomplimentary to the intelligence of the public, as that of our correspondent, we should at least try the experiment of making interesting to the mind objects not specially attractive to the eye. The experiment has yet to be systematically tried.

The criticism to be made upon our exhibitions generally is that they are mere displays of fine objects, and those who look at them are not able to learn what they are. Even the wing-case of the diamond beetle gains in interest by a few words of explanation, especially if the scales of a butterfly's wing are shown beside it and their relation to it briefly stated. The

New York Microscopical Society was the first to attempt to materially improve this condition, and its annual programmes are excellent in this respect.

Whether the plan suggested possesses any merit whatever in large gatherings or not, it is unquestionably the one that is most satisfactory at home, when entertaining a friend with glimpses of microscopical life. In this connection the plan is not a new one, and probably every reader has made frequent applications of it.

At an annual exhibition in which the descriptive programmes are carefully arranged, like those of the New York Society, for example, the plan might readily be carried out. The whole scheme consists in selecting several objects—it may be only three or four in each group—that will, so to speak, explain each other, placing these in proper sequence, with suitable descriptions on the programme.

The indisposition of the public to acquire knowledge is proverbial, but the prevailing opinion on this subject may also be unjust—at least the extent to which it is true may be very much exaggerated in our minds. There are 300,000 visitors to the National Museum in this city in the course of a year. They do not all come for amusement, but a very large proportion of them examine the collections with deep interest, and endeavor to add to their store of knowledge.

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## NOTES.

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—If any reader should know of an old form of microscope of American manufacture that would be of interest in a collection to illustrate the progress in improvement of stands in this country, the editor would be pleased to receive information concerning it. A collection of old microscopes will, probably at no very distant day, be on exhibition in this city, such as will be of great interest to every microscopist. A nucleus for a complete collection of this kind, embracing not only American but foreign instruments, has already been secured by Dr. Billings for

the Army Medical Museum. We would esteem it a favor if readers who know of such instruments, that might be obtained now or at some future time, would kindly give us the desired information for future use.

—One of our correspondents has a full set of the *Monthly Microscopical Journal* and the continuation of it, the *Journal of the Royal Microscopical Society*, to the end of 1884, all bound, which he is willing to sell very cheap. If any reader desires to obtain the set we will be pleased to afford any assistance possible.

—Dr. Lardowsky has highly recommended a new staining fluid for the cellulose walls of plant cells and to reveal karyokinetic figures. It is obtained from ripe huckleberries. The juice is pressed out and diluted with twice its volume of water, and a few drops of alcohol added. It is then boiled and filtered hot. In use it is diluted with water. It stains objects that have been hardened with chromic acid. By staining a section and then plunging it into a one per cent. solution of acetate of lead a lilac color may be obtained.

—Mr. Carl Zeiss is about to publish a new catalogue of his microscopical apparatus, which will include, among other new things, an apparatus for photomicrography, which has been very favorably spoken of by those who have seen it. Messrs. Emmerich & Son, the agents for Mr. Zeiss in this country, will soon have a supply of the catalogues, and doubtless will also have an invoice of the latest productions at an early day.

—The trip made by Mr. Wolle to Florida, which was mentioned in these columns some time ago, has led to the discovery of at least twenty species or varieties new to our flora, although no specially good localities for collecting algæ were found.

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## CORRESPONDENCE.

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### Microscopical Exhibitions.

TO THE EDITOR:—I enclose a programme of our last exhibition. You must not be too severe upon these affairs. Your ideas upon microscopical subjects are usually very correct, but I cannot help thinking that you are a little in error on that point. Your plan for soirées would be excellent if an audience of microscopists could be secured. But the general public does not want to be instructed as

much as it wants to be amused, and a programme on your plan would hardly be as attractive to an average audience as the kaleidoscopic affairs now in vogue. By making such a display as attractive as possible, the result will be, I think, that more persons will become interested in microscopy—at first superficially; but finally deeply—than by any other method. From what I have seen and heard I firmly believe that some of the best workers in the line of microscopical research have originally had their latent aptitude in that direction awakened by the sight of some pretty object at the house of a friend or at a microscopical soirée.

Hope your JOURNAL is doing as well financially as it is in every other way.

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## NOTICES OF BOOKS.

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*Annual Report of the Operations of the United States Life-saving Service for the Fiscal Year ending June 30, 1884.* Washington: Government Printing Office. 1885. (8vo, pp. 476.)

*The Influence of Cocaine, Atropine, and Caffeine on the Heart and Blood-vessels.* By H. G. Beyer, M. D., M. R. C. S., Passed Assistant Surgeon U. S. N., Honorary Curator, Section Mat. Medica, U. S. National Museum. (Pamphlet, pp. 31.)

An account of experiments conducted at the Museum of Hygiene, at Washington, by the author. They were made on the heart of the terrapin. The method of experimenting is fully described and the results given in detail. Cocaine and atropine act similarly upon the heart. Morphine in considerable doses antagonizes the effect of cocaine. Caffeine increases the rate of pulsation, and strengthens the contractions, and appears to be cumulative in its action. The article was originally published in the *Amer. Journ. Med. Sciences*.

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## Exchanges.

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[Exchanges are inserted in this column without charge. They will be strictly limited to mounted objects, and material for mounting.]

Wanted: Well cleaned and selected Foraminifera, for which cash will be paid or slides given

EDWARD C. DAY,  
Riverside, Conn.

Hundreds of varieties of fresh-water Algæ, including Volvox, Desmids, Rivularia, Draparnaldia, Tetraspora, &c., &c., for selected exchanges by list.

J. M. ADAMS,  
Watertown, Md.



# THE AMERICAN MONTHLY MICROSCOPICAL JOURNAL.

VOL. VI.

WASHINGTON, D. C., SEPTEMBER, 1885.

No. 9.

## Mounting Media of High Refractive Index.\*

At the meeting of the American Society of Microscopists at Cleveland, Prof. H. L. Smith described his process of mounting in media of high refractive power, and gave the formulas for preparing the same, and we are enabled to present the following abstract, which embraces the principal points of interest. The white medium, which has a refractive index of about 1.7, is very easily prepared, and is pronounced by Prof. Smith, and those who have used it, as unchangeable, provided moisture is kept out. The following is the formula as given for this:—

A stiff glycerin-jelly is first made, about the consistency of honey, by dissolving clear gelatin (Cox's) in pure glycerin, by aid of heat, and, in two fluid drams of this, forty grammes of pure stannous chloride are dissolved. The solution is easily effected by a little heat. When this solution is made it will probably be somewhat milky, but by boiling it in a test tube it will become beautifully clear, and about the color of balsam. This boiling must be done in a test tube not over one-fourth full, as the bubbles are, towards the last, very large, and thrown violently up and liable to eject the fluid from the tube; but with care the whole may, in a short time, be made not only clear, but, when cold, about as stiff as thick balsam; and, if in a small vial, it is not readily poured out. This medium should be used in making mounts pre-

cisely as balsam is when the mounts are to be finished by heating. The bubbles escape very rapidly and easily, but towards the end of the boiling, as the medium becomes viscid, they are inclined to persist, but by carefully heating, using a small flame, they will disappear, and, indeed, as they are mostly steam, they will frequently disappear wholly in cooling, when a balsam mount under the same circumstances would be full of bubbles.

If the boiling has been sufficiently prolonged, on cooling the cover will be found to be pretty firmly attached, and will allow the excess of material to be cleaned off without danger to the mount—indeed, this excess should be hard, requiring a knife or a sharp edge to remove it. It is advisable to put on only so much as is necessary to fill in under the cover, and have no cleaning to do afterwards, or put on a minute drop, and if that should not be enough feed in a little more from the end of the small glass rod used for dipping: The best thing to clean off the excess is hydrochline acid—a bit of tissue paper rolled up and moistened with this, not too wet, serves the purpose admirably, but water may also be used, and is nearly as good.

As the medium is deliquescent it is necessary to use a protecting ring. For this purpose, after the slide is well cleaned around the cover-glass, and warmed to dry it, apply a good coat of zinc-white cement, or shellac, colored to suit the fancy. If the sealing is perfect there will be no change by time. It is recommended, how-

\* Revised by the author.

ever, to use a wax ring. These rings, punched out of sheet wax, of such size as to cover the edge of the thin glass, are put on the mount when it is finished, and, by cautious application of a small flame, just melted, but not so as to run. If any bubbles form under the ring they may be removed by touching with a hot needle or pin-point before the wax cools. A mount made this way will stand indefinitely, and can, at any time, receive a supplemental colored ring of shellac or other varnish for a finish. *Amphipleura pellucida* is very beautifully shown in this medium, and the various pleurosigmas—indeed, all diatoms except the very coarse ones, which appear almost black in the medium. A very little experimenting will enable one to use the medium successfully.

The use of the gelatine is only to give such a hold upon the cover as will permit the necessary pressure in cleaning. Many mounts have been made, both by myself and others, in the earlier experiments with this medium, without the gelatine, but in all these cases the cover was less firmly attached to the slide. If the protecting ring keeps out moisture from immersion media, or the atmosphere, the mounts will remain unchanged. As the medium dissolves gelatine, albumen, etc., arranged diatoms must be fastened to the cover by heating the latter, supported on a bit of thin sheet-iron or platinum, nearly to melting or softening point. A larger proportion of the stannous chloride can be dissolved than that mentioned above, even as much as sixty grammes, but then, on heating to harden the mass, crystals will appear; the crystals never give any trouble when forty grammes are used.

The second medium is realgar, the transparent sulphide of arsenic, dissolved in bromide of arsenic by aid of heat. Both of these substances should be pure, and the mount should be boiled as long as

bubbles are readily given off, with considerable heat, and when cold the cover should be more firmly attached than with balsam. These mounts are of a deep lemon-yellow color, and the compound has a refractive index of 2.4. Excellent, and even better, mounts, as to permanence, may be made by using realgar only by sublimation. A bit of the realgar is put on a plate of mica about one inch square, and thick as a penny. This is melted by strong heat of a spirit-lamp. On this mica plate is placed another, with a hole  $\frac{5}{8}$  of an inch in diameter, and above this a thin glass plate with a hole slightly less than the glass cover on which the diatoms are mounted.

In Fig. 25, *a* and *b* are the two mica



FIG. 25.—Method of mounting with Realgar.

plates, *c* the glass plate, and *d* the cover, with the diatoms facing the realgar. The whole is now supported on a metal ring. A strong heat will volatilize the realgar without change, and often a clear deposit is made all over the diatoms and underside of the cover, and the latter can now be mounted in balsam; but, if bubbles are formed in the operation, as probably will be the case, the heat must be continued till these disappear, and, as the deposit will now be thickest at the centre just over the realgar, the mount may be finished by putting the cover, realgar side down, on a clean slide, and on top of it, to prevent breaking, a piece of thick glass, and then, grasping tightly with forceps to give pressure, heating strongly over a spirit-lamp. The realgar will soften (it must not be melted, else bubbles will form which cannot be removed) and spread out, more or less, between the cover and slide, making a nice clear mount. The color of the heated realgar is very much deeper than when cold. Instead of the solid realgar a drop of the solution



in bromide of arsenic may be used, but in this case it must be boiled to expel the most of the bromide, before the cover is placed above it; the solid compound now melts at a much lower temperature than the realgar alone. These mounts will not change, but those made from the solution directly will, if the ingredients are not entirely pure, containing no excess of either sulphur or arsenic.

Prof. Smith stated that Dr. Allen Y. Moore was an independent discoverer of the value of realgar as a medium for test-diatoms, though, owing to its high melting point, he had not been able to make satisfactory mounts with it. He also stated that Dr. Van Heurck, to whom he gave the formula some time ago, had written to him that, with materials prepared for him by Rosseau, of Paris, he had no trouble in making excellent and permanent mounts. As bromide of arsenic will dissolve both sulphur and arsenic, there is always danger, if the realgar is not pure, that there will be an excess of one of these, and if so, the mount will either crystallize or granulate.

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### Butter and Fats.\*

BY DR. THOMAS TAYLOR,

*Microscopist U. S. Department of Agriculture.*

Since 1876, when my first paper was published on Butter and Fats, in the *American Quarterly Microscopical Journal*, I have devoted a good deal of time to the investigation of this subject, principally with the view of finding a method by which I could, by the aid of the microscope, detect butter from butter substitutes. As a result of many experiments, I find that a person experienced in the use of the microscope may distinguish the fats of various animals and of vegetables by following the methods herein described.

The experimenter should first pro-

cure a specimen of common lard. This is composed mostly of crystalline starry forms which represent the solid fat of the lard. Real lard is composed of these and the oil common to lard. In very hot weather, when the thermometer is up in the nineties, the crystals dissolve in the oil, and perfect crystals cannot then be obtained unless cooled slowly to about 70° Fahr.

Place a drop of sweet oil on a glass slide with the point of a needle. Place a small portion of the lard in the oil, and mix them together. Place a microscopic glass disc over the lard and oil mixture and press gently. If held up to the light white granules will be seen if the temperature is not over 80° Fahr.; these are fatty crystals. Under a low power of the microscope it will be observed that these crystals have stellar forms with dark centres, and spines radiating from them (fig. 7).

To procure normal crystals of beef kidney fat, render a piece of this fat in an iron pan, without water. Strain, and add sufficient sweet oil to bring the fat to the consistency of butter. Cool slowly for a period of from twelve to twenty-four hours. Mount in oil as directed in the case of lard. The crystals in this case present quite a different appearance from those seen in lard (fig. 8). View them by polarized light, with and without selenite plate. The beef crystals, to be seen to advantage, require a power of at least 500 diameters, being very small, although they appear very interesting objects with a power as low as 80.

When it is desired to examine the crystals of butter, boil about an ounce of pure, newly-made butter in a test tube or iron spoon for a period of several seconds; allow it to cool as directed in the case of beef and lard; place a few grains of it on a slip of glass; pour over it a few drops of alcohol (or better, alcohol nine parts, carbolic acid one part), separate the crystals with a pin, and view them with a pocket lens; they will appear

\* Abstract of paper read before the American Society of Microscopists, August, 1885.

like the eggs of insects (fig. 1). Place a second portion of the same butter on a glass slide  $3 \times 1$  inches; combine it with a drop of sweet oil by means of a pin, reducing the butter to granules; cover with a thick disc of glass, and view first with plain transmitted light, when crystals like fig. 2 will be seen. Second, by

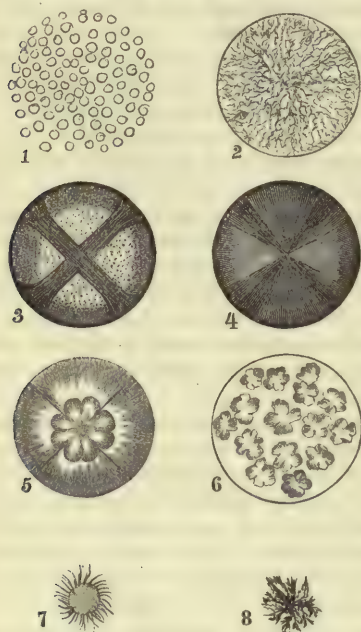


FIG. 26.—Butter and Fat.

polarized light. In this case place the polarizer low down and turn this prism round until its face angle crosses the face angle of the analyzing prism above. Under these conditions a dark ground is produced, and the butter crystals, which are globular in form, are seen in bold relief. The butter globular crystals will now exhibit a well-defined black cross representing that known as St. An-

drew's (fig. 3). Figure 4 represents a crystal of butter showing divisions produced in prismatic colors when the selenite plate is used with polarized light. If old butter or a poor oily butter is used in this experiment, the secondary crystals of butter are generally shown. These crystals are of rosette form, much smaller than that of the globular, and exhibit no cross (fig. 6).

The globular crystals of butter, when kept for a month or more, seem to bud like a vegetable spore, and frequently every round crystal will show projecting from each a smaller crystal (fig. 5). The globular forms generally vary from fifteen ten-thousandths of an inch to the one-hundredth of an inch in diameter. These forms are never seen in pure beef or lard fats. Care should be observed not to press the crystals flat, especially the globular crystals, as the cross is not seen when severely pressed.

Butter crystals vary slightly from each other in size and in some other slight particulars, such as color. A butter received from Tennessee, made from milk of Holstein and native breed, shows on its crystals indentations, a condition represented in no other butter yet observed. The butter crystals seen in the butter made at Mr. Frank Ward's dairy of Washington, from milk of Alderney cows, also differ in some particulars from all others examined, being darker in color, spines longer, and of larger size. Specimens intended for permanent use should be mounted with a varnish ring, to prevent the cover from pressing on the crystals, and to prevent the movement of the cover used to protect them.

#### EXPLANATION OF FIGURES.

1. Represents crystals of boiled butter as seen by a pocket lens.
2. A single crystal of butter, highly magnified, viewed by transmitted light only.
3. A crystal of butter viewed by polarized light only. It exhibits the cross of St. Andrew.
4. A crystal of butter as seen under polarized light

- and selenite plate. In this case beautiful colors are displayed, while the cross is but faintly seen.
5. Represents what seems to be a budding butter crystal.
6. Represents the rosette crystals of butter.
7. The crystalline form of lard.
8. The crystalline form of beef.



**American Society of Microscopists.**

The eighth annual meeting of this society was held at Cleveland, Ohio, beginning the eighteenth of August. About one hundred and forty members were present. The following account of the proceedings is taken mainly from the columns of the *Cleveland Plain Dealer*; some of the details are from a correspondent who was present.

The proceedings were opened by an address of welcome by Mr. C. M. Vorce, President of the Cleveland Microscopical Society, who said:—

GENTLEMEN OF THE AMERICAN SOCIETY AND VISITORS: It is literally true that words are inadequate to express the gratification that the members of the Cleveland society experience in being here to welcome your coming to this city. It is an event that we have looked forward to for years. The pleasure of making the acquaintance of many gentlemen not only in our own pursuit but in other branches of science and attracting them to our city has long been the subject of our anticipation. To realize the consummation of such an event, we have waited in patience for a favorable opportunity to invite you to our city. We at last concluded to invite you without further delay, although the facilities we offer might not be all that you could wish. While the Forest City offers innumerable attractions and inducements for visitors to sojourn with us, it is singularly wanting in buildings containing halls suitable for a convention of this kind. From the responses we have received from members and others interested in microscopy, we have every reason to anticipate a large attendance, a gathering of more than usual interest and the accomplishment of valuable results, which will add luster to our society. I take pleasure in introducing to you Mayor George W. Gardner.

Mayor Gardner said that he took pride in extending to the society, in behalf of the city, a hearty welcome;

that he took pride in the fact that such a large body of men of high intelligence had chosen Cleveland as their meeting place. He declared that he had no doubt the meeting would be productive of great results, not only to the society but to science.

Prof. H. L. Smith, LL. D., President of the American Society, said in response, that he thanked the mayor for his words of welcome. 'We come from all sections of the country to your beautiful city, than which no more appropriate place of meeting could be chosen. Fifty years have passed since my first visit to Cleveland. There existed then for those days a palatial hotel kept by Mr. Scoville. At that time Ohio City on the west bank of the river was the ambitious rival of Cleveland, and bade fair to overshadow her glories. I look in vain for some of the old landmarks that then existed. They have been swept away with the flight of time, and others have taken their places. At that time there existed here a building called the ark, not because it resembled Noah's ship, nor because there were gathered there all sorts and kinds of creatures, but because there were assembled there the scientific and literary men of Cleveland, young men full of ambition. Well do I remember their first microscope. They thought it a wonderful instrument. Then they got a more wonderful one, but even that was far inferior to what we now have.'

Following the President's address Rev. Jabez Hall, a member of the Cleveland society, offered prayer.

The first paper read was by Prof. D. S. Kellicotton 'A New Floscule,' to which he has given the name *Floscularia Millsii*. Dr. F. L. James spoke on the 'Shrinkage of Cement Cells; the Cause of Leakage in Glycerin Mounts.' He stated that the fault in preparing specimens is not due to the zinc but to the persons using it. The cement should be properly made, and when used for making cells the latter should be al-

lowed to harden until they will shrink no more from loss of the volatile solvent. The hardness may be known by testing with the thumb nail. No time for drying can be stated, as it varies with the weather. The leakage is due to shrinkage of cells not sufficiently hardened.

Hon. J. D. Cox then read an article on 'The Actinic and Visual in Microphotography with High Powers.'

The President, Prof. H. L. Smith, delivered his address in the evening. His subject was 'The Influence of Science Studies.' After a few well-chosen words by way of introduction from Mr. Cox, he said:—

As I was writing this address far from home came the news of the death of Thaddeus C. Up de Graff, one of nature's gentlemen, and an eminent biologist, who did much for the success of this society. As a microscopist and physician he must long have known the inevitable result of the disease that was preying upon him, but he was always of good cheer. I wish that some one else might have been selected to give you the history of what has been done in microscopy the past year. While in a general way I may touch upon that subject, I shall take as my theme the unconscious influence of natural science study on the development of society. We are apt to lose sight of those quiet influences which are affecting our social life. The speaker then, in the course of his address, likened the progress of this influence to the steady movement of the world. Cyclones and tempests may claim all our attention for a time, but the world keeps on in its course undisturbed by those influences.

Happily, we in the study of microscopy are untrammelled by metaphysical thoughts. We microscopists do not trouble ourselves with cause and effect, but leave the leaven in the lump, feeling assured that it will in time leaven the whole. The old world has passed away. The age of the hero has passed away. The

people have arrived. Science has arrived, and theology, law and all are on trial. Those who devote their lives to scientific research develop a love for truth. Do not think that I claim that the study of nature is all, however. There are men who look upon the scientific man as one who must snap, snarl, and sneer, and that where science appears religion must retire. It is a real relief to turn aside from this distrust to men who have made ears dull with pain hear the sweet music of nature. In discussing the depreciation of labor and the tyranny of office, men have often, in offering remedies, put in motion forces which, if uncontrolled, would have done more harm than good. The plans for the absorption of railroads and telegraphs by the government are miserable failures. We must solve the difficulties that confront us with some other power. We must have a unification of nations in the good work, and this is already shadowed in a universal system of time and of weights and measures.

A civilization based on science cannot so revert. Our trustworthy hopes for a glorious future are based on scientific research. No one is more to be pitied than the pessimist and agnostic. We, as students of nature, are not dependent on metaphysics, but find at our doors constantly the evidence of the truth.

Professor Smith hinted at the great work already accomplished by the study of science which has resulted in the ocean cable and other inventions having a bearing on our comfort and progress. He said that he presumed that all the members of his society are believers in the Darwinian theory, and spoke of the evidences of development as shown in a pure tone from the pulpit and bitter things from the forum and the exchange. It was far from his purpose, he said, to urge a further study of science in the schools and more science from the pulpit. All this will come in time.



Such a student as he who discovered the influence of the electric current on the magnetic needle has done more for the world than the demagogue who struts his brief time on the stage of human existence and then disappears.

The speaker referred satirically to those good old days when men grew old before their time; when geologists were considered akin to infidels; when the divine right of kings was believed in, and the luxuries which we now enjoy were unknown. It is quite the fashion to rave about those good old times, but we would not want them back again. We would scarcely give up our railroads and telegraphs and our table luxuries, now necessities, for the good old times. As we look upon the luxury of the present as compared with the past we may ask, 'How did our grandmothers live?' They did not live, growing old as they did before their time, but they were comparatively far advanced beyond what their ancestors were. Every gathering like the present has its benefit in human progress. We sometimes hear of conflict between science and religion, but it is only apparent. It was but a few years ago when good men looked upon geology as akin to infidelity, forgetting that astronomy had at one time been considered equally dangerous, but had come to be recognized as attesting the glory of God. So in time geology has become recognized as not in conflict with true religion. Professor Smith said that he could remember when physicians were shy of the microscope. To-day, while there are a few old practitioners who shrug their shoulders distrustfully when the younger physicians use the microscope, even the old ones are unconsciously affected in their practice by advancement in microscopical investigations. The president spoke of biology, which owed its existence to microscopy, and which has worked a revolution in medicine. Anything that can claim to aid us in

copmg with contagious diseases, with blights upon our crops and diseases in our flocks, is of intense interest to the public, and it is with these that biology deals. It is in its infancy yet, but it is destined to become more and more important. The speaker said that it had been shown that the two hundredth millionth part of a drop contains enough bacteria to be deadly infectious. He said that when it is shown that ventilation and sewage have been greatly benefited by microscopic investigations, it may be considered fortunate that some men have microbes on the brain, as has been said in jest. He said that biology may yet prove that the infinitesimal organisms with which it deals are not alone concerned with disease, but with health as well, and that they, acting in the pores of the human system as workers, carry off the sewage of the system, and thus overcome the effects of violations of nature's laws, and thus work to the end of aiding man in working out in himself the theory of the survival of the fittest. He said that microscopy has a great work to do in geology, and thus in affecting the commerce of the world. It has been said, 'Make it unfashionable for men to drink and gamble, and our sons will stay away from the saloon and the gambling hell.' Fashion cannot be compared in its force with the influence of science studies on man. The had-carrier, who climbs the ladder with his burden, is better and happier for that which has been accomplished by scientific research, which, with its electric lights and telephones, have done so much to lift him out of the ditch in which his fathers were.

The professor did not claim everything for scientific research, but likened it to the carefully made balance-wheel in the chronometer, which, although but a part of the delicate machinery, is an essential part.

[To be continued.]

## Optical Arrangements for Photomicrography, and Remarks on Magnification.\*

BY ROMYN HITCHCOCK.

There are two methods of obtaining amplification in photographing microscopic objects; one is by regulating the distance of the sensitive plate, the other is by the interposition of an eye-piece, or a supplementary lens, usually an acromatic concave, between the objective and the sensitive plate. It is the relative merits of these two methods that we propose to briefly discuss.

The fact that both methods are used by different persons with perfectly satisfactory results might lead to the inference that it is purely a matter of convenience. This, however, is not the case; for the ordinary eye-pieces are not very perfect optical instruments, and it can scarcely be supposed that they will preserve the perfection of an image formed by an objective, in all its details. The conditions in photography are somewhat different from those of ordinary observation, wherein the defects of the ocular are not noticeable. The eye fails to discover a curvature of the image which is very evident when the latter is spread over a flat focussing screen six or eight inches square. In photography much depends upon whether the operator uses large or small plates, for with a small plate giving a field of three or four inches very high magnification can be satisfactorily attained by the aid of an ocular. For ordinary purposes such plates are quite large enough, but when we come to large sizes, such as eight by ten-inch plates, the eye-piece will not give sharp definition all over the field.

The eye-piece enables one to obtain increased magnification with short camera-bellows, and we have seen small photographs of difficult subjects taken with the eye-piece which leave nothing to be desired.

Nevertheless, for the more difficult objects, and whenever finest details are to be photographed, we would not advise its use. By far the better plan is to use a long camera-box, and get amplification by increase of distance. In this way very good results can be obtained, but it must be observed that the objective requires to be specially corrected for the distance of the plate, and this is not only inconvenient, but in many cases quite impracticable. Thus, in using an objective of the oil-immersion form without any collar adjustment, one can only focus the image on the plate by causing the objective to approach nearer to the object than where it is used in ordinary observation.

Another plan which has been highly recommended by Dr. Woodward, Dr. Van Heurck, and others, is to make use of an amplifier. Dr. Van Heurck's very ingenious device has been described on page 45 of the current volume. Dr. Woodward was the first to point out the advantages of the amplifier in photomicrography, and also to give instructions for its proper application.

In working with objectives corrected with the utmost care for a definite length of tube, it is obvious that any change in the course of the rays passing through the objective will introduce aberrations which will impair the definition. If we focus upon an object with the ocular, then remove the ocular and receive the image upon a focussing screen several feet away, the objective must be moved nearer to the object in order to give a sharp image on the screen. Shortening the working focal length in this way obviously interferes with the normal course of the rays through the lens, and it is therefore not possible to obtain such a perfect image in this way as may be seen with the ocular. It will readily be seen that the only way to secure the best definition is to focus the objective with the ocular, for then we know the corrections are properly adjusted, and

\* Read before Section G, at the meeting of the A. A. S., Ann Arbor, 1885, by Dr. H. G. Beyer, U. S. N.



then make the image sharp on the distant screen without the eye-piece by means of a supplementary lens. Mr. Zeiss attempted to do this by providing suitable correcting lenses to be screwed into the back of the objective, which were calculated to correct the aberrations when the screen is at stated distances away. A better plan, however, was employed by Dr. Woodward, who fully understood the problem and solved it in a satisfactory manner. He made use of an amplifier by Tolles, which he found to be most satisfactory of all at the time.\* The amplifier was placed in a draw-tube, so that it could be moved out or in as required. He found that for any given position of the screen there was a corresponding position for the amplifier at which the image was as sharp and perfect as when observed with an ocular, the objective meanwhile remaining unmoved. Herein is the secret of Dr. Woodward's unexcelled work in photographing the most difficult test-objects. He used no small plates, but the images of *A. pellucida* were ten inches in length, clear and sharp throughout. It is safe to assert that such pictures cannot be taken with an ocular, or even without the correcting lens properly applied. These facts are either not generally known, or they are sadly neglected by those who have most need to apply them; for in these days of photographing the most difficult of all objects, the various forms of bacteria, the utmost sharpness of definition is required if the results are to possess permanent value.

We now come to another question of importance in connection with this subject, viz., how much shall we magnify with each objective? We already know that there is a limit, clearly determined by calculation for each objective, dependent upon its numerical aperture, beyond which no further amplification will bring out additional details. Beyond that limit increase of magnification only

enlarges the details then visible. Experience clearly shows, also, that as we increase amplification beyond a certain point, with every objective, we lose in sharpness of definition. This should be borne in mind in photographing with the microscope. The negative should be taken with only such magnification as gives perfectly sharp definition. By far the greater part of the general photographic work of microscopists is done with powers not greater than 250 diameters, and rarely indeed is 400-500 diameters required.

This, however, will depend upon the work to be done. In photographing diatoms, Mr. J. D. Cox has used powers of a thousand and twelve hundred diameters very successfully, and Dr. Woodward's celebrated photographs of *Amphipleura pellucida* were taken with magnifications of more than two thousand diameters. The magnification of certain photographs in our possession is 2,700 to 2,900 diameters with a  $\frac{1}{8}$ -inch objective, and 3,400 with a  $\frac{1}{12}$ -inch. The frustules measure about ten inches in length. Considering this fact and the size of the pictures, embracing as they do the entire length of the frustules in perfect focus throughout, we regard these photographs as the most perfect that have yet been produced. They conclusively demonstrate that it is practicable to make photographs with the highest powers which shall equal the best definition the lens is capable of giving with such magnifications; but as there is a limit to the sharpest definition of every lens as ordinarily used in observing with an ocular, there must also be such a limit in photography. The rational method would seem to be to get a sharp negative with as much magnification as possible, and make enlargements from that if required. In working with an amplifier enlargements will seldom be desired; but without the amplifier, either with or without an ocular, the limit of successful direct magnification is much reduced.

\* See this journal, vol. i, p. 5.

A perfectly sharp negative will bear considerable enlarging without noticeable loss of detail. In an article published several months since\* reference was made to some negatives about the size of an English six-pence, of bacteria, which competent judges pronounced excellent. These bore enlarging to the size of ordinary lantern positives. These were taken without the eye-piece, in a very small camera attached to the tube of the microscope. The opinion was expressed that 'better negatives of bacteria and very minute objects can be produced without the eye-piece, by obtaining more perfect small negatives, than by original large negatives.' Dr. Van Heurck also, as recorded in these columns, holds to the same opinion. Nevertheless, one may carry a very reasonable opinion to such an extreme as to lose the value of it. There is no reason for making negatives so small that a lens is required to examine them. There is, in fact, a decided disadvantage, in that greater enlargement is required by a photographic copying lens, and however excellent such a lens may be, it will not hold its sharp definition when required to magnify. Therefore, it is advisable to make the negative from the microscope at least as large as a  $3\frac{1}{4}$  by  $4\frac{1}{4}$  plate will take.

Summing up this matter, we are personally inclined to favor the use of large plates, 8 by 10 inches for example, in photomicrography, using the lens with an amplifier instead of an eye-piece, for the reason that large pictures, highly magnified, can thus be obtained of exquisite definition. These will bear further enlarging with the solar camera. There remains, however, the consideration of expense, and the inconvenience of using such a large apparatus under ordinary circumstances. It is unquestionably more convenient, in most cases, to use smaller plates, and to work with an eye-piece. Still better, to use an amplifier in place of

the ocular, for then it is possible to attach the amplifier to the camera in such a position that when the object is focussed with the eye-piece, it is also in focus on the ground glass of the camera when the latter is attached. With such an arrangement a quarter-plate camera can be used with perfect satisfaction, giving negatives equal to any that can be made.

The same cannot be said when the ocular is used, although there is no doubt thoroughly satisfactory results can be obtained with the ocular on small plates, as already explained.

### Provisional Key to Classification of Algae of Fresh Water.—IV.

BY THE EDITOR.

#### III. ORDER CONFERVEOIDEÆ Kirchner.

Multicellular, filamentous algae, simple or branched, rarely spreading flat; cell contents green [except in *Chroolepus*], only rarely showing a definite arrangement, but usually an outer layer of colored plasma, or the entire plasma uniformly colored; cell-wall never siliceous.

It is probable that sexual propagation will be found universal in this order, but at present it has not been observed in all genera. Sexual propagation takes place by female cells (oogonia) which contain usually a single oosphere, rarely several, and male cells (antheridia) in which spermatozooids are produced.

Asexual propagation by swarm spores.

[The unbranched Confervoidæ are readily distinguished from the filamentous Zygosporæ by the uniform coloring of the cell contents in the former and the characteristic distribution of the color in the latter.

From what has been said above, it need scarcely be added that the division into sexual and asexual forms is merely tentative, for convenience.]

#### a. SYNZOOSPOREÆ and ASEQUAL FORMS.

Sexual fructification by spermato-

\* This journal, vol. vi, p. 28.



zooids not observed, but in a few cases copulation of two similar swarm spores has been seen. The product of such copulation is a zygospore (isospore) which passes through a resting stage, then grows and produces unsexual zoospores, which produce new plants.

Usually propagation takes place by the formation of one or numerous asexual zoospores within each cell. These are colorless at the front end, with a red pigment spot, and 2 cilia (microzoospores) or 4 cilia (macrozoospores). Both kinds are common in some genera, but only the microzoospores can copulate.

Resting cells of various kinds are found in most genera.

#### FAMILIES.

Filaments branched or unbranched, with or without gelatinous envelopes, cells sometimes ending in long bristles.

#### CONFERVACEÆ, VI.

Filaments branched, upper part of cells swollen, all endochrome passing from the lower part into the swollen portion.

#### PITHOPHORACEÆ, VII.

#### Family VI. CONFERVACEÆ.

Branched or unbranched filaments, cell-walls either delicate or thick, sometimes distinctly lamellose, with or without gelatinous envelopes or sheaths; terminal cells sometimes ending in long bristles or hyaline points.

Propagation by macro- and microzoospores, in some genera by resting-spores.

A. Filaments unbranched, or at most with short, lateral rhizoids; terminal cell without hair-like termination.

Zoospores of two kinds, macrozoospores with 4 cilia, microzoospores with 2 cilia, 8 many in a single cell, which may copulate, or vegetate without copulating. Copulation produces a zygospore, which grows slowly to an unicellular plant, that produces a number of macrozoospores. Other resting-spores not observed. (ULOTRICHINÆ).

B. Filaments branched; lower cells converted into colorless rhizoids, terminal cells often provided with long hairs or bristles. (CLADOPHORINÆ).

a. Cell-walls delicate, 2-16 zoospores formed in one mother-cell, with 4 cilia, set free by rupture or swelling up of the mother-cell. (CHÆTOPHOREÆ).

b. Cell-walls thick; zoospores very numerous (at least 32) in one cell, set free through an opening in the cell-wall, with 2 or 4 cilia. (CLADOPHOREÆ).

c. Spreading, flat, in a single layer of cells, either leaf-like, smooth, or crisped, or in the form of a hollow tube. (ULVINÆ).

#### A. ULOTRICHINÆ. Group I.

#### Synopsis of Genera.

Filaments tortuous, with short lateral proliferations. *Rhizoclonium*, 55. Cells rarely exceeding diameter in length; walls delicate.

#### *Ulothrix*, 56.

Cells longer, usually turgid, contents granular. *Conferva*, 57.

Filaments like *Ulothrix*, parallel, in gelatinous envelope.

#### *Schizogonium*, 58.

Filaments large, not branched; walls distinctly lamellose and thick.

#### *Chatomorpha*, 59.

55. Genus *Rhizoclonium* Kützing. Filaments like *Conferva*, but distinctly tortuous (bending back and forth), with short, lateral, pointed proliferations or rhizoids.

56. Genus *Ulothrix* Kützing (extended).

Simple filaments, basal cell extended to a rhizoid. Macro- and microzoospores, the latter copulating (as observed in *U. zonata*); both set free while the cell-walls swell and break up.

[The genus as thus constituted includes *Hormiscia*, Areschoug, a genus usually recognized, characterized mainly by thick and robust cell-walls, often distinctly lamellose.

In the sterile condition it is difficult to distinguish between *Conferva* and

*Ulothrix*. In the former the cells are usually longer in proportion to diameter, more robust, and the contents more granular. In *Ulothrix* the cells are rarely longer than their diameter, the cell-walls thin, contents effused.

The formation of macrozoospores is very readily observed in this genus: it is only necessary to place the filaments in a saucer with water over night and examine them the next morning, when the zoospores will probably be set free.]

#### 57. Genus *Conferva* Kirchner.

Simple series of cells, like *Ulothrix*; only microzoospores observed, but no copulation of them. They are formed in great number in a mother-cell, and escape through a circular opening in the wall.

[The genus as thus formed includes *Conferva* Link and *Microspora* Thuret: This union of the two genera is to be commended for the present at least; for it is practically impossible to distinguish between them except by the generic character of *Conferva* 'propagation unknown,' while *Microspora* produces zoospores in all its cells. It is stated by Wille that resting-spores are produced in the genus *Conferva*, which probably produce zoospores when they germinate. Until these observations receive further confirmation it seems proper to retain the genus as it is. *Conferva* Link includes usually slender filaments, with rather diffused and granular pale cell-contents. In *Microspora*, on the other hand, the cells are usually more turgid, the color more pronounced, and the contents have a tendency to contract toward the centre, finally producing numerous zoospores.

This genus also includes a peculiar form, *Psychohormium* Kützinger, which is especially characterized by incrustations of calcareous or ferruginous matter.]

#### 58. Genus *Schizogonium* Kützinger.

Filaments like *Ulothrix*, with

rather thick cell-walls, growing side by side in a common gelatinous envelope, forming more or less broad bands. In moist places, aerial.

[It is doubtful if this genus is a good one. It is supposed that *Schizogonium* is a condition of *Ulothrix*.]

#### 59. Genus *Chaetomorpha* Kützinger.

Filaments thick walled, distinctly lamellose, cartilaginous, with rhizoid attachment; cells before division equal in length or longer than the diameter, after division shorter than the diameter; basal cell longer than the others; cell-contents green, finely granulate with a few starch grains, parietal in old cells.

[Most of the species are marine. This genus closely resembles *Cladophora*, and only differs from it in being unbranched.]

#### B. CLADOPHORINÆ. Group 2.

##### a. *Chaetophoræ*. Sub-group 1.

a. Filaments in gelatinous sheaths, with rhizoids.

#### *Synopsis of Genera.*

Endophytic. Filaments irregularly branched, with bristles.

##### *Chaetonema*, 60.

Main filament large, with lateral fascicles of smaller branches.

##### *Draparnaldia*, 61.

Branches like the main stem; chlorophyll in transverse bands.

##### *Stigeoclonium*, 62.

Filaments branched, radiating, in gelatinous or hard hyaline envelope spherical, or in a flat layer.

##### *Chaetophora*, 63.

60. Genus *Chaetonema* Nowakowski.

Endophytic. Filaments thread-like, irregularly branched, with spreading branches, usually at right-angles, most cells bearing one or several terminal or median bristles, somewhat swollen at the base.

Multiplication by breaking up of the branches: propagation by zoospores formed from the entire contents of the swollen cells at the ends or the middle of the branches, or after previous division into two or four



parts. Zoospores egg-shape, with four cilia and a red pigment spot.

[This genus is endophytic in the gelatinous envelopes of such algæ as *Tetraspora*, *Chaetophora*, *Batrachospermum*, etc., growing along and winding about the filaments of the latter.]

61. Genus *Draparnaldia* Agardh.

Main filament larger than the branches, colorless, or with less color than the latter, bearing bright green clusters of smaller branches differing also in form from the main stem; terminal cells of branches end in colorless hairs. All the cells of the branches may form resting-spores. The entire plants, enveloped in slimy mucilage, forming soft, shapeless masses.

[The very pronounced difference between the main stem and the branches of this plant enable the genus to be recognized at a glance. Usually the coloring matter of the cells of the main stem is arranged in a more or less broad band across the cells. In at least one species it has been observed that the fascicles of branches (the main stem of the branches being likewise larger than the others) may grow into new plants, sometimes sending out rhizoids from the basal cell. This is a very beautiful alga, not uncommon.]

62. Genus *Stigeoclonium* Kützinger.

Principal stem not distinct in size or form from the branches, with green contents, or colorless; the ultimate branches not aggregated into distinct fascicles. Otherwise like *Draparnaldia*. Resting-spores produced in the last branches.

[The terminal cells of some of the species end in long, colorless hairs. The green contents are usually arranged in transverse bands across the cells. The formation of zoospores and their escape from the ruptured cells can frequently be observed in this genus.]

63. Genus *Chaetophora* Schrank.

Stem and branches alike, radiately arranged, or forming layers of definite

form. The entire plant surrounded with a firm gelatinous envelope, sometimes very hard. The cells of the ultimate branches form chains of resting-spores.

[These plants are often found attached to submerged leaves, twigs or other plants, in the form of minute, solid particles of transparent jelly of a dense green color. The chlorophyll is usually arranged in transverse bands, as in *Draparnaldia* and *Stigeoclonium*. The terminal cells are often attenuated, and may appear quite empty. Zoospores may frequently be seen forming in the cells.

The more or less hard, or coriaceous, hyaline envelope which surrounds the filaments is not characteristic of this genus, as it is found also among the Nostocaceæ. The green color of the filaments and the manner of branching prevents any liability to error in distinguishing between them.]

β. Filaments without gelatinous sheaths; no rhizoids.

*Synopsis of Genera.*

Articulated, branching filaments, spreading irregularly over surfaces, cells with long bristles.

*Aphanochæte*, 64.

Filaments upright, branched, terminal cell obtuse.

*Microthamnion*, 65.

64. Genus *Aphanochæte* A. Braun.

Filaments prostrate, creeping, growing closely attached to a surface, often on larger filamentous algæ, branching and spreading irregularly. Some of the cells bear long bristles either at their apex or on the back.

65. Genus *Microthamnion* Nägeli.

Filaments articulate, upright, straight, dichotomously or trichotomously branched, sometimes very much branched; terminal cell obtuse, without bristle, afterward swollen, forming a sporangium. Distinguished by the peculiar method of branching—the lower of two cells sends out a lateral growth in which the dividing wall is formed, not at the point where the branch originates but a short distance above it.

Contents effused, with starch granules.

[The plants of this genus are quite small, and appear to have at times a gelatinous investment. The cells are sometimes distinctly swollen or turgid.]

b. CLADOPHOREÆ. Sub-group 2.

*Synopsis of Genera.*

Aerial branching filaments; contents reddish or bright red.

*Chroolepus*, 66.

Filaments branching; cells robust, much longer than the diameter; branches becoming smaller than the main stem.

*Cladophora*, 67.

Filaments branching once or twice; cells short, often torulose.

*Gongrosira*, 68.

66. Genus *Chroolepus* Agardh.

Filaments irregularly branched, often so felted together that it is difficult to recognize the branching. Cells with red or reddish brown contents, sometimes turning green after death. Zoospores usually as many as 32, reddish brown, with two cilia. No rhizoids; resting-spores unknown. Aerial algæ, often with a strong odor of violets.

[The color of the filaments is often distinctly yellow or orange. The cell-walls are thick and firm. The algæ are found on rocks where water trickles down, as a somewhat thick, leathery growth.]

67. Genus *Cladophora* Kützinger.

Filaments many times branched; the last branches much thinner than the primary. Cells robust, usually several times longer than thick, with green contents and usually numerous starch granules; the first cell with a rhizoid.

Zoospores, with 2-4 cilia, formed in great number in a mother-cell. Resting-spores not known.

[The cell-walls are very thick, often lamellose. The cells are frequently very long in proportion to their diameter. The green contents seem to be quite uniformly distributed over the inner wall of the cells.

This genus has numerous representatives among the marine algæ.

*Chaetomorpha* (59) resembles this genus so closely that it is only to be distinguished by the absence of branches.]

68. Genus *Gongrosira* Kützinger.

Filaments usually dichotomously or simply branched, branches as thick as the principal stem; cells with thick walls, with green contents. The lower cell with a filamentous rhizoid. Resting-spores. Living in water or aerial.

[The filaments are not repeatedly branched as in *Cladophora*, and the cells are quite short, either equal in length to their diameter, or twice as long, often constricted at each end so as to form torulose filaments.

Rabenhorst describes two genera under his family Gongrosireæ which we have not regarded as sufficiently distinct from *Gongrosira* to be maintained as independent genera. Their characters are briefly given as follows:—

Genus *Pilinia* Kützinger. Erect, articulate filaments, simply or sparsely branched, attached, in a crustaceous, spongy stratum, of an olive color. Propagation unknown.

Genus *Chlorotylum* Kützinger. Filaments dichotomously branched, erect, parallel, in thin, pulverulent stratum, not laterally connected, not vaginate. Elongated hyaline cells interspersed in the filaments between short, tumid cells with colored contents. Zoospores 4-16 in a single cell.]

[To be continued.]

—o—

—The microscopical exhibit of the U. S. Department of Agriculture at the New Orleans exposition, prepared by Dr. Thomas Taylor, was made up in great part of water-color illustrations of fungi. Of these there were 800 plates, representing nearly 700 species. The remaining exhibits showed the results of experiments on butter, fats, and fibres of various kinds treated with reagents. A catalogue of the exhibit is published and can be obtained by application.



## EDITORIAL.

**Publisher's Notices.**—All communications, remittances, exchanges, etc., should be addressed to the Editor, P. O. Box 630, Washington, D. C.

Remittances should be made by postal notes, money orders, or by money sent in registered letters. Drafts should be made payable in Washington, New York, Boston, or Philadelphia.

Subscription-price before April 1st, \$1 per year, in advance. All subscriptions begin with the January number. After April 1st the subscription-price will be \$1.50.

The regular receipt of the JOURNAL, which is issued on the 15th of each month, will be an acknowledgment of payment.

The first volume, 1880, is entirely out of print. The succeeding volumes will be sent by the publisher for the prices given below, which are net.

Vol. II (1881) complete, \$1.50.

Vol. III (1882) complete, \$2.00.

Vol. IV (1883) complete, \$1.50.

Vol. V (1884) complete, \$1.50.

Vol. V (1884), Nos. 2-12, \$1.00.

**AMERICAN ASSOCIATION.**—Our columns are so fully occupied this month that only brief mention can be made of the proceedings at Ann Arbor, and this must be confined to the microscopical section, although in the section of biology many important articles were read.

Prof. S. H. Gage was presiding officer of the section of Histology and Microscopy; Mr. W. H. Walmsley, secretary. Mr. Walmsley read an article on 'Photo-micrographs on gelatin plates for lantern projection,' and gave a practical demonstration of photo-micrography by lamp light.

Prof. Burrill presented a communication on 'Photo-micrography with high powers.' Mr. Chas. Porter Hart described 'A new, cheap, useful, and quickly constructed microtome,' and Dr. H. G. Beyer read an article by the editor of this journal, which is published on another page.

The address of Prof. J. P. Leslie, the retiring President of the Association, deserves careful reading. It is published in *Science* of August 28th.

**AMERICAN SOCIETY OF MICROSCOPISTS.**—The success of the meeting at Cleveland must be judged from the condensed account of the proceedings, which will be completed next month. These, although mainly taken from the newspaper reports, bear the stamp of careful preparation,

and we must express our appreciation of the excellent character of the reports in the *Plain Dealer*, which are much better than the accounts of scientific meetings in the daily papers usually are.

There is no doubt all who attended the meeting were well pleased. Personally we are, and have been since the beginning, especially interested in the 'working session.' In spite of some trifling misunderstanding between a few members last year, which it was thought might injuriously affect the operations at Cleveland, Mr. Vorce has had a thoroughly successful working session, which is largely due to the energy and hard work he has given to it. We are pleased to notice that next year Mr. Griffith, who has done so much to establish the working session, will again have charge of it.

Prof. Kellicott is already at work on the Proceedings, which will probably be published at an early day.

We publish this month some of the important papers read at the meeting and others will be printed next month.

The meeting next year will be held at Chautauqua.

—o—

**CHEESE POISON.**—It will be remembered that some time ago considerable was said in the newspapers about some cheese which was said to be poisonous, in Michigan. At the time a number of chemists and microscopists examined specimens of the cheese, among others Dr. Sternberg, who was looking for the bacteria. Dr. V. C. Vaughn recently read a paper giving an account of his researches on this subject before a meeting of the Michigan Board of Health, an abstract of which we have received.

Dr. Vaughn finds that a poison, which he names tyrotoxin, is produced in cheese under certain conditions, and he has succeeded in isolating it in the form of crystals. It is supposed that the poison is produced by putrefactive changes, and it may therefore prove to be a product of bac-

terial growth, although this is not so stated in the abstract before us. It is said, however, that 'old, foul-smelling cheese, such as Limburger and Schweitzer, have not been known to be poisonous.' Usually it is home-made cheese and cottage cheese that becomes poisonous, although sometimes it is cheese made in large factories. Such cheese instantly turns litmus paper red.

As regards the poison Dr. Vaughn says:—

'It is a product of slight putrefaction in the cheese, which probably occurs in the vat, as the curd has been known to poison a person. By this slight putrefaction, or excessive fermentation, as it may be called, a large amount of butyric acid is formed, and this, in the presence of the casein of the cheese, is capable of developing a poison. The poison was obtained in long needle-shaped crystals, which are freely soluble in water, chloroform, alcohol, and ether.' The smallest visible fragment of a crystal placed upon the end of the tongue causes a sharp, stinging pain at the point of application, and, in a few minutes, dryness and constriction of the throat. A slightly larger amount produced nausea, vomiting, and diarrhœa. The poison is volatile at the temperature of boiling water, and for this reason even poisonous cheese may be eaten with impunity after being cooked.'

—o—

**POISONOUS DRIED BEEF.**—It appears from the following highly intelligible paragraphs from the *Evening Post* of New York that somebody out West has been poisoned by eating dried beef. It also appears that two physicians, one of them a member of the State Board of Health of Illinois (which, by the way, we have hitherto supposed to be composed of gentlemen of somewhat different qualifications than are indicated in this instance), have submitted the dried beef to a microscopical examination. Making all possible allow-

ances for the proverbial inaccuracies of newspaper reports, there is doubtless a trace of accuracy in this one, enough to justify the present notice.

'KANKAKEE, ILL., July 15.—Dr. Utley, of the State Board of Health, has completed an investigation at Mokence of the dried beef poisoning, and says the poisoning was surely caused by the meat. He says further: "After a careful examination it seems impossible that the person putting up the meat did not know it was poisonous. The exact nature of the poison, because of the inferior microscopic facilities here, I am yet unable to determine. The investigation is necessarily incomplete, because no *post-mortem* examination was held. Were the powers of the State Board of Health enlarged, the guilty parties in such cases could be more quickly found and punished."

'Dr. Ellis, of Kankakee, a consulting physician in the poisoning cases, says: "From a partial examination under the microscope of the impure beef, I find a marked characteristic to be a very unpleasant odor, made more apparent on being macerated for a short time in pure water at an ordinary temperature. I find a total breaking down of the muscular fibres. This destruction of muscular tissue also means entire obliteration of the fibrous covering of the muscle with the blood corpuscles and fatty tissues, which leads me to believe that this beef was taken from an animal diseased, or more probably one partly decomposed, before being submitted to the so-called process of curing." No more deaths from this sickness have occurred, though several are yet in a critical condition.'

The evidence offered by Dr. Utley, in spite of the 'inferior microscopic facilities,' is scientifically complete—in fact, the meat was poisonous, because Dr. Utley says so.

Dr. Ellis, however, doubtless having adequate microscopic facilities, discovers an odor by a partial microscopical examination! He also finds that if the meat is macerated for a short time in pure water at ordinary temperatures, the 'marked characteristic odor' becomes more apparent! We should think it might—the probabilities are that the learned doctor is quite right in this conclusion, if in no other.



It is unfortunate that 'no more deaths from this sickness have occurred.' A portion of the meat should have been fed to the doctors before they had an opportunity to report on it.

The *Journal* of the American Medical Association contains another account of the poisonous beef, wherein it is stated that a severe form of cholera morbus occurred in Mokena, Illinois, on July 17th, due to the eating of decomposed dried beef. About forty persons were affected. The *Journal* reprints the reports of Drs. Utley and Ellis, and adds that 'Dr. Keyser, on microscopical examination with 600 diameters, found numerous animalculæ,' which is likewise a highly instructive statement for a professional gentleman to make!

Prof. G. A. Mariner found numerous micrococci, bacilli, and other bacteria, so it appears that in spite of the reports of the other gentlemen there really was something the matter with the meat.

—o—

TESTING OBJECTIVES.—Not unfrequently we are asked by persons wishing to purchase objectives, to advise them what kind they should get, and if we will test the lenses before they are selected. It is not a difficult matter for one familiar with microscopic work to select a good objective for every-day use. There is a vast amount of humbug talked about this matter by persons who ought to know better. Perhaps, after all, it is mostly for effect upon the novice, who, no doubt, is inspired with envy for the person whose long experience enables him to subject an objective to various 'tests' to determine what it will do. But the fact is, as every practical observer well knows, the best test for a working objective is to use it in regular work for a short time. It is well to have also a good *Podura* scale, which is an excellent object to show the character of the definition.

When we come to a different class

of lenses, of very large angular aperture, such as are now much in demand by amateurs who can afford them, and by others who must have them, the difficulties are somewhat greater. It is customary to try such lenses upon a test-plate, and report how many of the diatoms it resolves. Unfortunately, this is a very misleading test. It will do very well for those who desire a lens for such work alone; but for most other purposes it is not a test in any sense.

In this case also the most satisfactory test for the lens is practical use in the work to be done with it. Many an observer of unquestionable skill in microscopical examination would be utterly 'at sea' if asked to resolve the *Amphipecta*. Yet we are inclined to believe such an observer is quite as well qualified to pass judgment upon an objective as any other.

There is, however, one way of testing an objective thoroughly, in every particular, and that is by means of the test-plate of Professor Abbe, made by Mr. Zeiss. This test-plate deserves to come into general use by those who make a study of objectives.

This subject was treated at length some time ago by Dr. H. E. Fripp, and we can do no better than to use his words in conclusion. He says:\*

'In ordinary practice, microscope objectives, if tested at all by their possessors, are simply subjected to a comparison of performance with other lenses tried upon the same "test objects." The relative excellence of the image seen through each lens may, however, depend in a great part upon fortunate illumination, and not a little upon the experience and manipulative skill of the observer; besides which any trustworthy estimate of the performance of the lens under examination involves the consideration of a suitable test-object, as well as the magnifying power and aperture of the objective. The structure of the test-object should be well known, and the value of its "markings," if intended

\**Journ. R. Micr. Soc.*, ser. 2, vol. iii, p. 120.

to indicate microscopical dimensions, should be accurately ascertained, care being taken that the minuteness of dimensions and general delicacy and perfection of the test-object should be adapted to the power of the lens. A fairly correct estimate of the relative performance of lenses of moderate magnifying power may, doubtless, be thus made by a competent observer, but it is not possible from any comparisons of this kind to determine what may or ought to be the ultimate limit of optical performance, or whether any particular lens under examination has actually reached this limit.

Assuming the manipulation of the object to be as perfect as possible, and, further, that the test-object has been selected with due appreciation of the requirements of perfect optical delineation, a fair comparison can only be drawn between objectives of the same magnifying power and aperture. Which of two or more objectives gives the better image may be readily enough ascertained by such comparison, but the values thus ascertained hold good only for the particular class of objects examined.

### NOTES.

—After an experience of three years with balsam of tolu as a mounting medium, M. G. Amann recommends it for the mounting of diatoms in preference to Canada balsam. In the *Bulletin* of the Belgium Microscopical Society he says:—'It has given me excellent results, and comparative trials have shown that its optical properties are at least equal to those of storax. Moreover, its preparation is simpler; it suffices to discolor one part of balsam in two or three parts of chloroform, and filter the solution.' It is more deeply colored at first than storax, but becomes decolorized with time, especially if exposed to light.

—According to experiments by Prof. J. Richard, published in *Zoologischer Anzeiger*, the chlorhydrate of cocaine promises to be a valuable reagent for killing certain organisms, such as bryozoa, worms, and hydras. A small colony of bryozoa is placed in a watch-glass with 5 c. c. of

water. When fully extended, about half a cubic centimetre of solution of cocaine to each cubic centimetre of water is added, little by little. After five minutes these animals, which, under ordinary conditions, retract their tentacles on the least agitation of the water, remain extended in spite of violent shocks. Another  $\frac{1}{2}$  c. c. of cocaine solution is now added, and after ten minutes the animals are dead and fully expanded. This reagent should be tried on other animals, and the results recorded, as the author believes its application may be greatly extended.

—A very interesting experiment, showing the influence of light upon the formation of starch in leaves, can be readily performed according to a method recently described by Sachs. To show the starch grains a leaf must be bleached and made transparent in this way: The fresh leaf is placed in boiling water for ten minutes, after which the chlorophyll is extracted by placing it in alcohol. The color is thus removed without rupturing the cells, which retain the starch. The latter is then made visible by treatment with iodine. The cellular tissue becomes stained dark blue or lighter, according to the quantity of starch present.

Comparative experiments may be made by exposing half of a leaf to sunshine while the other half is protected. A leaf collected in the evening contains much more starch than in the morning.

—The Association of the Alumni of the Albany Medical College have published the proceedings of their twelfth annual meeting in a pamphlet of 68 pages. It contains an address by Horace T. Hanks, M. D., president of the association, and two lectures by William H. Thomson, M. D., on the germ theory of disease.

—To color brass diaphragms or other articles black or steel-grey, the *Brit. Journ. Phot.* says, take a quarter of an ounce of sulphate of copper and half its weight of hyposulphite of soda, and dissolve them in a little more than a pint of water. Thoroughly clean the article, place it in the solution and heat it. More hyposulphite will give a darker tint, more sulphate of copper a lighter steel-grey color.

—Several years ago an English gentleman, Mr. Charles Blackley, attempted to determine the number of grains of pollen floating in the air, and also their distribution. He collected them upon squares of glass coated with a sticky medium and counted the number of grains found. In some experiments the squares were sent



up in the air attached to kites, and exposed at definite heights. He found a far greater abundance of pollen grains in the upper air than below.

—At the Inventions Exhibition in London, Messrs. R. & J. Beck received a gold medal award for their microscopical and other optical apparatus. The Messrs. Beck have been constantly improving their designs for microscopes, and now offer some excellent models at very reasonable prices.

—Mr. Hinrichs, of Baltimore, has sent us, for examination, some new preparations of bacteria, recently received from Germany, which he is offering for sale. Among them we find as especially good *Bacillus ovina*, and a preparation marked *Enclo-carditis ulcersa*, Koch. These are from Marpmann's Institute at Esens, Germany.

—It appears from experiments of M. Miquel that bacteria do not rise to great heights in the air. Ten cubic metres of air at heights of 2,000–4,000 metres on the Alps failed to yield any bacteria. Hence it is concluded that Koch's cholera microbes cannot pass from Italy to Switzerland unless they find their way through the tunnels.

—M. P. Francotte has written an excellent article explaining the formation of images in the microscope according to the theory of Prof. Abbe. It is published in the *Bulletin de la Société Belge de Microscopie*, No. iv. It is an elementary exposition of the subject, illustrated with cuts, and affords a good insight into the theory.

—At a recent meeting of the San Francisco Microscopical Society, Mr. William Norris presented to the society a set of nineteen slides, mounted by him, being the first instalment of a series which, when completed, is intended to be a complete collection of all known California diatoms, with a list giving the generic and specific names of the diatoms found on eight of the slides, from as many different localities in the State, and comprising both recent and fossil forms. It is the first important step ever taken towards the systematic collection and classification of the California diatomaceæ.

The consideration of the subject appointed for discussion, 'Pathogenic Bacilli,' was then taken up. Dr. J. H. Stallard, of San Francisco, read a carefully prepared paper, giving a succinct account of the present state of our knowledge on the subject. He briefly reviewed the gradual progress of discovery in this field

from the time when Leeuwenhoek, the father of microscopic biology, first discerned that minute organisms were associated with putrefaction and decay, up to the present day, when the magnificent researches of Koch, Pasteur, Lister, and others are exciting the admiration of the entire scientific world. It is to M. Pasteur that we owe the first observations which connected an epidemic disease with the presence of a parasite. He taught the silk-raisers of France how to check the ravages of pebrine, a disease infecting the silkworm. By following his advice the silk crop, which had fallen from 26,000,000 kilogrammes to 4,000,000, again increased to its former quantity. At a still more recent date, Lister made the discovery that the exclusion of germs and the use of applications which prevent their growth and propagation would render the practice of surgery far more successful. By the almost universal adoption of his methods many operations are now safely performed which formerly resulted fatally in nearly every instance.

In April, 1882, Koch announced his discovery of the bacillus of tubercle. These bacilla are minute rod-like fungi, and are readily found in the sputum of consumptives, generally free, but sometimes in colonies, in the large or 'giant' cells. They form spores at the temperature of the body, and human sputum retains its virulence after drying for considerable periods. Dr. Stallard then proceeded to detail the various methods of staining the material containing the bacilli, and thereby differentiating the latter.

In 1883 Koch was sent to Egypt by the German Government to study the etiology of cholera. After a series of prolonged observations he saw that a peculiar comma-like form of these minute fungi was invariably associated with the disease. In the appearance, growth, and vital properties of this bacillus, many characteristics were found which at once distinguished it from all its congeners. No formation of spores has yet been discovered. In uncomplicated cases of cholera, these bacilli appear as pure cultivations in the intestine of the patient, and their number is stated by Koch to always bear a direct proportion to the gravity of the attack.

Although the correctness of Koch's conclusions has been denied by the members of the British Cholera Commission, yet, taking everything into consideration, and bearing in mind the wonderfully careful and exhaustive nature of Koch's researches, it seems almost certain that the

soundness of his views will soon be established beyond all reasonable doubt.

In conclusion, Dr. Stallard gave a brief account of what is known regarding the bacillus of leprosy, showing it to be highly probable, although not yet demonstrated, that this organism is the cause, as well as the invariable accompaniment, of the disease.

The subject of the paper was further elucidated by means of engravings representing the appearance of the various bacilli, their modes of growth, the methods used in their artificial cultivation, etc. A number of slides had been carefully prepared, showing the bacilli of consumption and of leprosy, and these were exhibited under two microscopes, using a Powell & Lealand oil immersion  $\frac{1}{18}$  inch objective, and a glycerin immersion  $\frac{1}{4}$  by Tolles. An authentic specimen of Koch's common bacillus was also shown.

— We have received from Mr. W. H. Bulloch a photograph of a new microscope stand, which he has recently designed especially for lithological purposes. There are some peculiar features about it, and Mr. Bulloch has promised to write a description of it for publication. Probably it is not too much to say this is the most complete lithological stand made. The price is \$300. Mr. Bulloch has recently furnished one of his largest stands to the Army Medical Museum.

## NOTICES OF BOOKS.

### *The Technology of Bacteria Investigation.*

Explicit Directions for the Study of Bacteria, their culture, staining, mounting, etc., according to the methods employed by the most eminent investigators. By Charles S. Dolley, M. D. Boston: S. E. Cassino & Co. 1885. (Small 8vo, pp. 12 and 263.)

This book is composed of such notes and memoranda as would naturally be brought together by a person long engaged in collecting the current literature of a subject. In this respect the record is an excellent one. The author seems to have consulted everything of value that has been published on the subject, and given a brief outline of the many different processes described. For a person engaged in investigations of this kind, not possessing the scattered literature of the subject, the work will prove to be of value, as showing what has been done. The processes, however, are given in such a condensed form that it is doubtful if they could generally be ap-

plied successfully by a novice. However, some of the more important methods are given at length, and the others can easily be found from the references. It is unquestionably a valuable book for the investigator, and is evidently the result of much labor on the part of the author very carefully done. There are more typographical errors than should be found in a book of its size.

### *First Lessons in Amateur Photography.*

A series of lectures delivered before the senior class of the Montclair High School by the principal, Randall Spaulding. New York: Scovill Manufacturing Company, W. Irving Adams, agent. 1885. (8vo, pp. 28.)

Seven lectures covering the ground well, by an author who is evidently well acquainted with his subject. The information given is precisely what the amateur wants to know. We would recommend this book in preference to some much larger and more pretentious.

### *Fourth Annual Report from the E. M.*

*Museum of Geology and Archaeology.* June, 1885. The Princeton Press. 1885. (Pamphlet. 8vo, pp. 24.)

Economy in type is perhaps laudable, but one might reasonably protest that the full name of a museum should be given on the title-page of an annual report. We are unable to say what the 'E. M. Museum' may be. However, it belongs to the College of New Jersey, and Prof. William Libbey, Jr., is the Director. In addition to the usual records of specimens received, etc., the report contains an account of the methods employed for hardening, embedding, etc. It is a useful report for reference by persons engaged in biological work.

## Exchanges.

[Exchanges are inserted in this column without charge. They will be strictly limited to mounted objects, and material for mounting.]

Diatomaceous clay from this place, and fine slides of Foraminifera, for fine slides, material or back numbers of A. M. M. Journal.

E. H. RICHARDS,  
Woburn, Mass.

Wanted: Well cleaned and selected Foraminifera, for which cash will be paid or slides given.

EDWARD G. DAY,  
Riverside, Conn.

Hundreds of varieties of fresh-water Algae, including Volvox, Desmids, Rivularia, Draparnaldia, Tetraspora, &c., &c., for selected exchanges by list.

J. M. ADAMS,  
Watertown, Md.



# THE AMERICAN MONTHLY MICROSCOPICAL JOURNAL.

VOL. VI.

WASHINGTON, D. C., OCTOBER, 1885.

No. 10.

## Device for Testing Refractive Index.\*

A new device for testing the refractive index of immersion media, and indicating how near an approach to homogeneity with crown-glass can be made, was described, at the recent meeting of the American Society of Microscopists, by Prof. H. L. Smith, who claims for this simple device superiority, both as to ease of manipulation and accuracy of indication, over the well-known wedge and bottle furnished by Mr. Zeiss.

In testing any medium for immersion purposes, but little more than a drop of the liquid is required, and the slightest variations of refractive index are indicated by a considerable latitude of motion, when, in the ordinary use of the wedge, these variations would be inappreciable. The instrument is used upon the microscope, and a reference to fig. 27 will

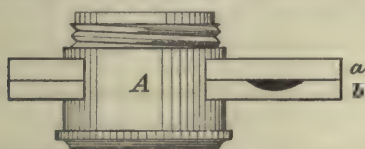


FIG. 27.—Device for Testing Refractive Index.

make the application plain. *A* is an adapter about three-fourths of an inch in length, with the society screw outside and inside. This is attached to the microscope, and carries a one-inch objective. *a* and *b* are two slips of crown-glass, as near the refractive index of the cover-glass as possible, two inches long and half an inch wide, each about a tenth of an inch in thick-

ness. In one of these, *b*, near the end, a concave is ground to a depth of about one-third or more of the thickness of the glass, and polished. To test whether a medium has the same refractive index as the glass, and also the dispersion, a drop of it is put into the concave, and the two slips of glass are placed together and inserted into an opening cut in the adapter-tube, as shown in the figure. A thin stratum of the medium will flow between the two slips. The whole being now in the position shown in the figure, the one-inch objective is screwed on below, and the microscope is focussed on some well-defined object on the stage. Looking through the two slips in this way, the focus will be found not to differ appreciably from what it would be if the glass plates were removed. When the object is clearly defined the plates are pushed in, bringing the concave, filled with the liquid, directly over the back of the objective; if the medium be optically homogeneous with the glass slips, there will be neither spherical nor chromatic aberrations produced, and the definition and focus remain unchanged. As none of the immersion media now known are strictly homogeneous in this sense, but may, nevertheless, have the same mean refractive index as the crown-glass, clear vision with these will be obtained with the general focus unchanged, but an excess of color will fringe the outlines of the object. If the focus has been obtained by means of the rack and pinion, the fine adjustment always remaining the same, one can readily ascertain the refrac-

\* Revised by the author.

tive indices of various media proposed for use with immersion objectives in this way. Let a mark be made on the rack-bar or sliding tube, as the case may be, when the focus is obtained with the plates in the position shown in the figure; this mark will indicate, for example, a refractive index of 1.52. Filling the concave now with cinnamon oil, and focussing again (using the same object, objective, and eye-piece), we get another position for a mark indicating refractive index of 1.6. Using water, we get still another, 1.33, and with glycerin 1.41, the extremes will be about half an inch apart, as measured on the bar or tube, and, by interpolating, we can thus get pretty nearly the refractive index of any fluid medium. I have found the so-called homogeneous media sold in the shops to differ very greatly, fully one-fourth of an inch out of the way in many cases. A specimen of cedar oil from Zeiss caused a change of focus only about one-twentieth of an inch, which was less than was required by any other samples I have tried.

When one has a fine objective, and with a given immersion medium has obtained certain positions of the screw-collar for the best work on certain tests, the exact refractive index of the medium can be ascertained, and afterwards always secured. A non-adjustable immersion objective, a  $\frac{1}{8}$  by Spencer, which performed most admirably, both with oblique and direct light with the medium furnished by the maker, showed but indifferently well with another medium, which, on being tested with the little apparatus above described, required an alteration of focus necessary to obtain distinct vision, or rather the most distinct vision, of fully one-fourth of an inch. On diluting the second medium to bring it to the same index as that sent out by the maker, the performance was entirely satisfactory. It will be understood that there should be a diaphragm in

the adapter of such size as will prevent any light passing through when the concave is put over the objective with the immersion fluid to be tested in it, except what actually passes through the fluid.

### —o— New Cement and New Mounting Medium.

Prof. Hamilton Smith has communicated to the Editor the results of some later experiments he has made with a new cement, especially adapted to protecting mounts in his new stannous chloride mounting medium, described in the September Journal. It is made by diluting a somewhat thick shellac cement, with benzole, and adding sufficient litharge to give a consistency about the same as that of white zinc cement. It dries very quickly, forms a much harder ring than does the white zinc cement, and is not unpleasant in appearance, as it becomes quite brown, or dark on exposure. A thin coat should first be applied, and when this is well dried it should be followed by another. So far as tried this cement seems to promise better than any other for preservation of the stannous chloride mounts. The white zinc often fails, and while the wax rings appear to answer admirably, the cement is more readily applied, and if the future use of it confirms the present promise, it will be more acceptable.

In regard to the medium itself, the refractive index may be raised considerably by making a saturated solution in the glycerin jelly—about 60 grammes to the fluid dram—and mixing this with the normal solution of 40 grammes. By a saturated solution is meant one which, when thoroughly cooled, will show signs of crystallization. The refractive index in this case becomes nearly 2.

Prof. Smith writes that he is now testing still another medium, of somewhat higher index than the stannous chloride, a full account of which will appear in due time.



### Mr. Grunow's Illuminator.

The Abbe illuminator, as constructed by Mr. J. Grunow, has already been referred to in these columns, and the method of using it, as explained by Mr. Grunow, given in full.\*

This month we present an illustration of the apparatus, from a wood-cut recently received (fig. 28). It will not be necessary to enter into a description of the instrument,

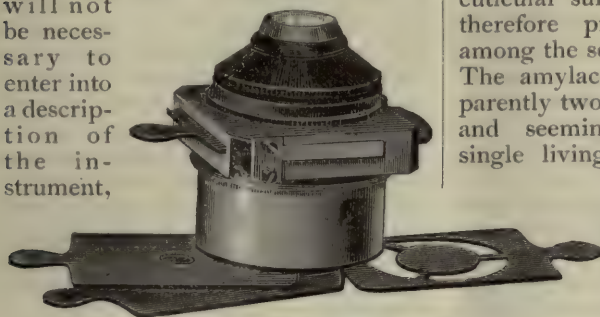


FIG. 28.—Grunow's Abbe Illuminator.

or to enlarge upon its value. The Abbe condenser, in its various forms, is not only the most extensively used, but it is also the cheapest and most generally useful, condenser now offered to microscopists.

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### Notices of New Fresh-Water Infusoria.—IV.

BY DR. ALFRED C. STOKES.

*Phacus acuminatus*, sp. nov. (Fig. 1).

Body depressed, broadly ovate or sub-orbicular, about as long as wide, the ventral surface slightly concave, the dorsal made convex by a sub-central, longitudinal keel-like elevation; cuticular surface longitudinally striate; posterior extremity rapidly tapering and produced centrally as a very short, straight, or slightly curved, acuminate tail-like prolongation; endoplasm colored green by chlorophyll corpuscles; pigment spot usually present; flagellum somewhat longer than the body. Length and greatest breadth  $\frac{1}{1000}$  inch. Habitat.—Sluggish streams, and ponds with *Myriophyllum*.

This approaches nearest *Ph. triquetra* (Ehr.), S. K., differing from it in the concave lower surface, and the short, usually straight caudal prolongation. The presence of the distinct ovate chlorophyll corpuscles gives the endoplasm its green color, but the discs are apparently confined to the part immediately beneath the cuticular surface, and the *Phacus* is therefore probably to be classed among the so-called symbiotic forms. The amylaceous corpuscles are apparently two only. They are small and seemingly subspherical. A single living active individual has been met with having the endoplasm perfectly transparent and entirely colorless. The cuticular striations are usually distinctly visible only in the dead and colorless

bodies.

*Ophryoglena ovata*, sp. nov. (Fig. 2).

Body ovate, soft, flexible and somewhat changeable in form, about one and one-half times as long as broad; ventral surface somewhat flattened; both extremities usually evenly rounded, the posterior one occasionally slightly and obtusely pointed, the frontal one commonly the broader; cuticular surface delicately striate longitudinally, the cilia fine and short; oral aperture ovate, ciliated, obliquely placed at a short distance from the frontal border, followed by a somewhat curved, apparently ciliated pharynx, posteriorly enclosing a vibratile membrane; contractile vesicle double, spherical, situated in the anterior and posterior body-halves, frequently stellate at diastole, and having long filiform diverticula; endoplasm colorless, crowded with irregular, colorless and variously tinted corpuscles; nucleus not observed. Length of body  $\frac{1}{100}$  inch. Habitat.—Still water, with *Ceratophyllum* and *Utricularia*. Movements rotary.

Of the unequal corpuscles crowding the body, the smaller more nearly

colorless ones are probably amylaceous in character, the large, variously tinted plates presumably being partially digested food-masses. The nucleus was not determined. It remained invisible even after the application to the body of reagents and staining fluids.

*Dexiotricha centralis*, sp. nov. (Fig. 3).

Body elongate sub-reniform or bean-shaped; longitudinally striate, about twice as long as broad, widest posteriorly, both extremities rounded; dorsal surface convex, ventral aspect anteriorly concave; oval aperture ovate, situated somewhat in advance of the centre of the ventral surface; pharyngeal passage short, recurved; cilia long and fine, those of the posterior extremity longest and most setose; caudal seta single, subequal to the body in length; adoral setæ fine, adcurved, extending in a single row obliquely across the right-hand lateral border, from a point posterior to the centre of the dorsal surface to near the centre of the right-hand margin of the oral aperture; endoplasm colorless, granular, transparent; nucleus not observed; contractile vesicle single, spherical, near the posterior extremity. Length of body  $\frac{7}{10}$  inch. Habitat.—Stagnant pond water, with *Lemna* and other aquatic plants.

This is readily distinguished from *D. plagia*, Stokes (*Amer. Journ. Sci.*, April, 1885), by the more posterior position of the adoral setæ and of the contractile vesicle, by the much greater proportionate length of the caudal seta, but especially by the entire absence of the apparently bi-concave corpuscles so abundantly present within the endoplasm of *D. plagia*.

As is usually the habit with the last named form, *D. centralis* when taking food rests upon one side, the cuticular cilia in the rear of the adoral setæ then being comparatively quiescent, while those clothing the frontal region are in the most active movement, the currents thus pro-

duced, in both species, carrying the food-particles against the oblique setose hedge which deflects them toward the mouth.

*Stentor globator*, sp. nov. (Figs. 4 and 5).

Body subspherical, changeable in form, free-swinging or temporarily adherent by a long, narrow, retractile tail-like prolongation protruded from the centre of the posterior extremity; peristome field elevated, rounded, finely ciliated in concentric circles; cuticular cilia fine, arranged in longitudinal lines, longest posteriorly; hispid setæ long and numerous, extending at right-angles to the general surface; nucleus not observed; contractile vesicle double, spherical, posteriorly located. Diameter of the body  $\frac{3}{100}$  inch. Habitat.—Still water, with *Myriophyllum*.

This remarkable stentor widely differs from any hitherto observed, possessing some characteristics that will necessitate changes in the generic diagnosis as formulated by Kent. Most members of the genus are noted for the ease with which they change their shape, the alteration, however, being confined chiefly to a contraction and consequent change in the form of the entire body. Several species have been observed with very fine pseudopodic filaments emitted from the posterior extremity, but none, so far as I am aware, have been recorded with the peculiar ability which *S. globator* possesses of posteriorly protruding a soft, flexible, attenuate tail-like prolongation equal in length to the diameter of the body, to be subsequently entirely withdrawn, and again protruded when the exigencies of the situation demand. The appearance of this temporary caudal prolongation brings to mind a pseudopodic protrusion, since it has the ability to somewhat alter its contour by the formation of several irregularly distributed enlargements which may be speedily absorbed, the part then becoming a long, simple, attenuate prolongation, the extreme



tip of which forms the easily detachable point of support for the body. The entire tail-like part seems

When about to be absorbed or withdrawn into the body, it becomes very flexible, being flourished and curved

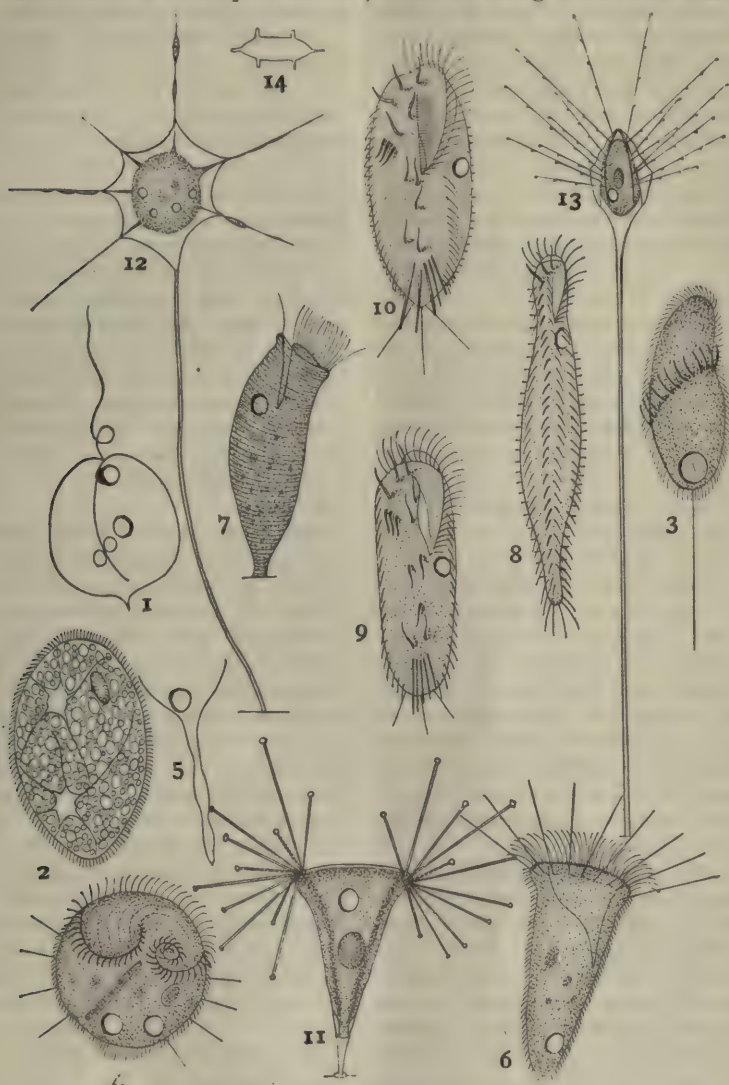


FIG. 29.—New Fresh-Water Infusoria.

to be covered by a cuticulum similar to that of the zooid, and is ciliated. | and twisted in an amusing manner. | Both protrusion and absorption are

EXPLANATION OF THE FIGURES.

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| Fig. 1. <i>Phacus acuminatus</i> X 700.                  | Fig. 9. <i>Stylonychia putrina</i> X 260.  |
| Fig. 2. <i>Ophryoglena ovata</i> X 110.                  | Fig. 10. <i>Stylonychia vorax</i> X 260.   |
| Fig. 3. <i>Dextrotricha centralis</i> X 700.             | Fig. 11. <i>Acineta fluviatilis</i> X 330. |
| Fig. 4. <i>Stentor globator</i> . Contracted body X 240. | Fig. 12. <i>Acineta lappacea</i> X 1200.   |
| Fig. 5. " Tail-like prolongation.                        | Fig. 13. <i>Acineta alata</i> X 200.       |
| Fig. 6. <i>Strombidinopsis seigeri</i> X 450.            | Fig. 14. " Ideal horizontal optic section  |
| Fig. 7. <i>Scaphidia constricta</i> X 300.               | of the lorica.                             |
| Fig. 8. <i>Uroleptus limnetis</i> X 216.                 |  |

accomplished rapidly. If this caudal prolongation is present, the convex peristome-field is conspicuously flattened, the body is narrowed and lengthened, and only at this time does the infusorian present any resemblance to the trumpet-like form so commonly assumed by other members of the genus. The entire body is soft and changeable in shape. Even when the tail-like part is not protruded, the infusorian then being a free-swimming animalcule, the changes are quite marked and extensive.

That the peristome field of *Stentor* is ciliated I have not personally observed in any other species except *Stentor polymorphus* and *S. Barretti*, in which the condition obtains, nor have I been able to find that such a state of the part has been noticed or recorded. It is probable that the peristome field is ciliated in all the species, but that it has not been recorded is somewhat difficult to understand. In *Stentor globator*, however, the ciliation is conspicuous. The peristome field is furrowed by concentric lines, fine cilia clothing the depressions. The nearest recorded approach to this condition is found in *S. pediculatus*, From., in which the peristome field gives origin to numerous papillæ bearing fine non-vibratile setæ.

The cirri composing the peristomal fringe are large and numerous. When at rest each one presents an appearance remotely similar to that of the adoral ciliary wreath in *Tintinnidium semiciliatum*, where each cilium is distally pectinated. After careful scrutiny, however, I have been unable to demonstrate the existence of such a structure. The appearance is probably due to a confused image of the intermingling adoral cirri and the finer cilia of the peristome field. The last named part is much more convex and more elevated than in *Stentor* generally, and the infusorian seems to have the amount of convexity under quite complete control.

The cuticular setæ are long and numerous. They are more conspicuous and apparently more abundant anteriorly than on the posterior parts. They also seem to vary in length in the same row, but the appearance may be due to the convexity of the cuticular surface. They may be extensible and retractile, but this I have not noticed.

The double spherical contractile vesicles are uncommon in the genus. Their existence in the present species would afford a ready clue to its identification, if anything more were needed than the peculiar form of the body and the characteristic changes of the posterior extremity.

In figure 4 is shown the globular body; in figure 5 the outline of the protruded tail-like prolongation.

*Strombidinopsis setigera*, sp. nov. (Fig. 6).

Body ob-conical, twice as long as broad, finely striate longitudinally; widest at the frontal border beneath which it is constricted, tapering thence to the rounded posterior extremity; peristomal cilia abundant, curving outwardly, their length not exceeding one-half the greatest width of the body; a series of fine, outwardly directed, hair-like setæ projecting from the cuticular surface behind the peristome border, their length equaling one-half the length of the zooid; pharyngeal passage wide, ciliate, extending to the centre of one lateral body margin; endoplasm colorless, transparent; contractile vesicle single, spherical, posteriorly located. Length of body  $\frac{1}{150}$  inch. Habitat.—Pond water.

This differs from *S. gyrans*, S. K., from English waters, the previously only known species, chiefly in the shortness of the peristomal cilia and the length and presence of the fine setæ springing from the anterior surface. Its movements are rapid and erratic. It has the habit of frequently darting backward for a short distance, at the same time contracting the frontal portion and partially



closing the peristome field, the adoral cilia being thrown inwards, some of them arching above the oral region, the frontal setæ then being almost parallel and directed forwards.

*Scyphidia constricta*, sp. nov. (Fig. 7).

Body elongate, gibbous, about three times as long as broad, constricted beneath the even, everted peristome border; widest near the centre, tapering posteriorly to the short intermedium of attachment; surface finely striate transversely; ciliary disc small, slightly elevated; contractile vesicle single, spherical, placed near the termination of the vestibulum; contracted body ovate, curved, strongly and transversely plicate on the concave side, the anterior border protruding as a conspicuous snout-like projection; parenchyma transparent, granular. Length of body  $\frac{1}{15}$  inch. Habitat.—Pond water; on *Nais*, often attached in pairs or in clusters of three or four.

In contour this resembles *S. inclians* (D'Udek), S. K., but it is readily recognized as a distinct form by the conspicuous anterior construction, the more posterior position of the pulsating vacuole, and by the transversely striated cuticular surface. When contracted, although the two still resemble each other, they may be diagnosed by the presence, with *S. constricta*, of the prominent snout-like projection of the frontal border.

*Uroleptus limnetis*, sp. nov. (Fig. 8).

Body elongate, sub-fusiform, five times as long as broad, widest centrally, tapering posteriorly to a tail-like prolongation forming about one-fifth the length of the entire body; constricted anteriorly into a neck-like portion, less in diameter than that of the body-centre, and about one-fourth the entire body in length; frontal border expanded, rounded, the lip conspicuous, crescentic; peristome field extending to the base of the neck-like constriction, the right-hand margin ciliate; frontal styles three;

ventral setæ in two closely approximated median lines, beginning immediately behind the frontal styles and continued through the caudal extremity; marginal setæ projecting, largest and most numerous posteriorly; contractile vesicle single, spherical, on the left-hand side near the apical extremity of the peristome field; nucleus double, ovate; immotile dorsal setæ long and numerous. Length of body  $\frac{1}{15}$  inch. Habitat.—Pond water, with *Lemna*; marsh water, with *Sphagnum*.

In its extended form this resembles the contracted condition of *Uroleptus longicaudatus*, Stokes, but, aside from the absence of the prolonged caudal extremity of the latter, differs in the absence also of the undulating peristomal membrane. The anal aperture was not observed. It, however, probably opens on the dorsal surface, as is so frequently the case in members of the Hypotricha.

*Stylonychia putrina*, sp. nov. (Fig. 9).

Body elongate elliptical, less than three times as long as broad; the frontal extremity slightly widest, the posterior border evenly rounded or truncate; lateral margins flattened, almost parallel, or the left-hand border somewhat concave; peristome field extending to near the centre of the ventral surface, the right-hand border ciliate and bearing an undulating membrane; marginal setæ large, projecting posteriorly only; four of the five anal styles extending beyond the posterior border; caudal setæ short, arising from the dorsal surface; nucleus double, ovate; contractile vesicle single, on the left-hand side; immotile hispid setæ short, arranged in four longitudinal lines on the dorsum; endoplasm often filled with dark granules. Length of body  $\frac{1}{15}$  to  $\frac{1}{10}$  inch. Habitat.—A stale vegetable infusion. Movements rapid and erratic.

This is readily distinguishable from other species by the shape of the body, the elongated, subelliptical

contour being thus far characteristic. The truncated posterior extremity is apparent only in the largest and presumably the oldest individuals, and not always with even them. Reproduction is by transverse fission and by encystment with subsequent binary fission, the external cyst wall being smooth.

*Stylonychia vorax*, sp. nov. (Fig. 10).

Body elongate, obovate, more than twice as long as broad, tapering and obtusely pointed, sometimes evenly rounded or obliquely truncate, posteriorly; frontal border prominent, obliquely crescentic; lateral margins often flattened and parallel; marginal setæ large, scarcely interrupted posteriorly, those on the left-hand side remote from the body-margin and projecting only at the posterior extremity; distal extremities of all the anal styles extending beyond the body-margin; caudal setæ stout, not widely separated, rising from the posterior margin of the body; peristome field extending to the centre of the ventral surface, the right-hand border nearly straight, ciliate and bearing an undulating membrane; contractile vesicle single, spherical, near the termination of the peristome, on the left-hand side; nucleus double, ovate; dorsal surface bearing one or more longitudinal rows of short, immotile, hispid setæ; frontal and anal styles often fimbriate. Length of body  $\frac{1}{300}$  inch. Habitat.—Shallow ponds in early spring.

This is the smallest member of the genus yet observed, and its characters are so obviously different from those of previously recorded species that it is easily recognizable. Two specially noteworthy features are that all the anal styles project beyond the body, and that the caudal setæ spring directly from the edge of the posterior border, and not, as in *S. mytilus* Ehr., *S. notophora*, and *S. putrina*, from the dorsal surface.

The infusorian is voracious, devouring the numerous flagellate or-

ganisms so abundant in the shallow pools in early spring, until the body becomes not only colored by them, but gorged and often distorted by the internal pressure. It was this remarkable appetite that suggested the specific name.

*Acineta fluviatilis*, sp. nov. (Fig. 11).

Lorica sub-triangular, compressed, transparent, thin and delicate; about one and one-third times as long as broad, widest at the distal border, somewhat constricted anteriorly, thence tapering posteriorly to the pedicel; lateral borders flattened, the lorica thus presenting a quadrangular outline in horizontal optical section; frontal margins united anteriorly except at the two ovate antero-lateral apertures for the passage of the tentacles; pedicel short, not exceeding one-third the length of the lorica, usually slightly widened at the distal extremity; enclosed zooid generally entirely filling the cavity of the lorica, to which it is attached at the posterior extremity and apparently by the entire lateral surface; endoplasm granular; tentacles distinctly capitate, in two antero-lateral fascicles; contractile vesicle single, spherical, anteriorly situated; nucleus ovate or broadly subspherical, conspicuous, subcentrally located. Length of lorica  $\frac{1}{300}$  to  $\frac{1}{600}$  inch. Habitat.—On *Valisneria spiralis* from a tide-water creek.

This may be regarded as the connecting link between the marine *Acineta tuberosa*, Ehr., and the fresh water *A. lemnae* Stein, both of which it resembles in the form of the lorica. Its systematic position is evidently between these species. From *A. tuberosa* it conspicuously differs in the short pedicel, the apparent adhesion of the entire body to the internal walls of the lorica, except at the anterior or distal border, and by its fresh-water habitat. The irregularly quadrilateral outline of the lorica in horizontal optical section are similar, as well as the habit,



possessed by both, of withdrawing the entire fascicle of tentacles at one time. In *A. tuberosa*, however, the tentacles do not possess the external spiral ridge-like film often visible in *A. fluviatilis*. The latter may very justly be considered the fresh-water representative of the marine type. From *A. lemnae* it is recognizable chiefly by the short pedicel, the posterior adhesion to the lorica, and especially by the presence of but a single contractile vesicle.

The lorica walls are often seen to be variously indented, bent and folded, the entire lorica being often reversed or inclined either by contact with Rotifera or other comparatively large denizens of its habitat, or by the necessary manipulations of the observer. Occasionally a portion of the soft body exudes through the apertures at the antero-lateral angles, thus lifting the extended tentacles for some distance beyond the walls; in a single instance a fascicle was entirely withdrawn and an irregular, curved process of sarcode was extruded from the tentacular orifice until its length equalled that of the entire infusorian, its shape and position slowly changing, a few minute vesicles appearing in it, but until I was compelled to leave the microscope no further alterations took place. The next morning the extruded part had been partially withdrawn, but the creature was weakened by prolonged confinement and the tentacles were not protruded. The act may have been induced by the discomforts of extended imprisonment and the consequent diminution of the oxygen supply.

The spiral film external to the tentacles is not always present. It is most frequently developed during the withdrawal or partial extension of the tentacle, when it is thrown into irregular, closely approximated ridges, the full extension of the organ elongating the spirals until they become merged into its substance.

At the systole of the contractile vesicle a narrow channel very fre-

quently becomes visible leading from the vacuole to the distal border of the zooid.

*Acineta lappacea*, sp. nov. (Fig. 12).

Lorica hyaline, subspherical, the borders projecting outwardly in numerous, conspicuous, irregularly distributed tubuli through which issue the fine tentacles; pedicel slender, often flexuous, two to three times as long as the lorica; enclosed body sub-globose, not attached to the lorica posteriorly; nucleus small, spherical, subcentral; contractile vesicles several, small, scattered. Diameter of the lorica  $\frac{1}{1000}$  to  $\frac{1}{1000}$  inch; of the enclosed zooid  $\frac{1}{3000}$  inch; length of pedicel  $\frac{1}{800}$  to  $\frac{1}{600}$  inch. Habitat.—Pond water; on rootlets of *Lemna* and on *Riccia fluitans*.

This approaches more nearly to *A. stellata*, S. K. than to any other member of the genus, differing from it in the greatly increased length of the pedicel, and in the multiple contractile vesicles. The tentacles are very fine, but exhibit conspicuous, irregular protoplasmic thickenings. Their length is often twice the diameter of the lorica. They vary in number from fourteen to eighteen or more. They are apparently not capitate.

*Acineta alata*, sp. nov. (Figs. 13 and 14).

Lorica irregularly ovate, widest centrally, the length not greatly exceeding the breadth, tapering anteriorly to the rounded or obtusely pointed border, and posteriorly to the pedicel, the walls thin, transparent, continuous, traversed longitudinally by from five to eight posteriorly diverging, compressed, wing-like elevations, each pierced by about four ovate, equidistant, longitudinally arranged apertures for the passage of the fascicles; pedicel six to eight times as long as the lorica, straight or slightly curved, its hollow cavity continuous with that of the sheath; enclosed zooid ovoid, somewhat changeable in shape, occupying the

anterior part of the cavity of the lorica, apparently not attached to the walls; endoplasm granular; tentacles fasciculate, all the distinctly capitate extremities usually placed on the same side of the fascicle, each of which consists of about six tentacles; nucleus ovate, subcentral; contractile vesicle single, spherical, posteriorly situated near the lateral border. Length of lorica, with pedicel,  $\frac{1}{8}$  inch; of the enclosed zooid  $\frac{1}{16}$  inch. Habitat.—Fresh water, on *Ceratophyllum*.

A single individual of this curious and beautiful acineta was first observed about three years ago; none have since been seen until recently, when they were obtained in some abundance. The projecting wing-like additions are very strongly flattened, the margins usually being undulate or irregularly crenate. It is difficult to rotate the lorica on its long axis so as to obtain a view of all the projecting alæ in succession, and to be certain of the exact number, the observer being forced to content himself with an examination of the opposite surface through the entire thickness of the semi-transparent animalcule. The usual number seems to be five; it varies, however. I have not succeeded in obtaining an end view; figure 14, showing a horizontal optic section of the lorica, is therefore not only diagrammatic, but to a certain extent ideal. The tentacles rarely exhibit an external spiral film.

### The Pseudocyclosis in *Amœba*.

BY G. C. WALLICH, M. D.,

Surgeon-Major Ret'd List, H. M. Indian Army.

In the March (1885) number of your valuable journal, Dr. S. Lockwood draws attention to the fallacy of the view still prevalent amongst naturalists in relation to the characteristic movements of granular and other particles within the body-substance of *Amœba*; and he furnishes the only rational explanation of the phenomena which is compatible with the readily observable facts of the

case. The title of Dr. Lockwood's brief but highly interesting paper, coupled with the arguments he brings forward, at once establishes his rejection of the idea that the movements of the particles referred to are indicative of the existence of a special circulatory function in the protoplasmic structure of this organism.

Having published, in *The Annals and Magazine of Natural History*,\* upwards of thirty years ago, a series of articles on the Amœban and Difflugian Rhizopods, in the course of which the quasi-circulatory movement of particles in the body-substance of *Amœba* was fully explained on precisely the same basis as that recently advanced by Dr. Lockwood (the term pseudocyclosis having then been assigned by me to the phenomenon, as will be presently shown), I venture to hope you will give the present communication a place in your columns. I would, however, at once assure Dr. Lockwood that I feel perfectly confident his conclusions on the subject have been arrived at quite independently of mine; and that it is a source of great satisfaction to me to find my own views have been thus verified by so painstaking an observer.

The following extracts from my papers, which could be multiplied were it necessary, will doubtless suffice to prove my statement:—

'Another fact is deducible from the appearances presented by the sarcode-substance of the largest of these *Amœba*. The rush of granules does not follow upon a previous contractile effort exercised at the posterior portion. As the animal progresses, occasionally altering its course, there are periods during which perfect quiescence is maintained by the granules; and the rush or flow of these seems to take place, as it were, to fill up the vacuum engendered by the sudden projection of a portion of the ectosarc in the shape of a pseudopodium. Hence it would appear that

\* London: Taylor & Francis.



notion is dependent on the contractile power of the external sarcode-layer, and that the endosarc only passively participates in it. If this view be correct, it involves a very important consideration; for it proves that the old German doctrine of a "primary contractile mucus" is essentially correct, and that the circulation is not dependent, even in part, on the alternate expansion and collapse of the contractile vesicle. Further than this, it affords the strongest confirmation of the high degree of "differentiation" existing between the endosarc and ectosarc of the amœban group.

'The mysterious faculty, resident in the latter portion of the structure, of forming *extempore* orifices for the inception or extrusion of food-particles, etc., may be witnessed in these specimens in a very singular manner, and one which, so far as I am aware, has not hitherto attracted attention. I allude to the projection of the ectosarc from some area of the general surface, in the form of a hemispherical mass with a broad base, only a very small portion of the original contour line seeming to give way at first, so as to admit of the passage of the endosarc and other granular contents into the newly projected part, but its entire floor appearing to be gradually dissolved, as it were, and free communication between the main body and the new pseudopodial cavity not being established until the completion of the process. Whilst this is progressing, the endosarc-granules seem to rush round a corner into the cavity, the corner itself gradually receding, so to speak, and being ultimately altogether obliterated. From these facts it is obvious that the ectosarc and endosarc are not permanent portions of the protean structure, but are mutually convertible one into the other; and that it is an essential feature of sarcode that, while the outer layer for the time being becomes, *ipso facto*, instantaneously differentiated into ectosarc, the same layer reverts to the condition of endosarc

under the circumstances just described.\* In the latter part of the process—that is, the reversion to the condition of endosarc—the action is by no means so instantaneous as when the converse takes place. In the actinophryans, both processes are, comparatively speaking, slow.'—(Further Observations on an undescribed Indigenous Amœba (*Amœba Villosa*, Wal.), by Surgeon-Major Wallich, M. D., *Annals and Mag. Nat. Hist.*, May, 1863.)

'The conversion of endosarc into ectosarc I regard as analogous in character, if not actually identical, with coagulation; the effect being produced by the mere contact of sarcode with the medium in which the animal resides, whilst the converse process constitutes an inherent vital function of the animal protoplasm. Should this view be admissible, we have presented to us a phenomena bearing, in a most important degree, on the general question of development, and one which, I venture to affirm, is far more largely engaged in the production of specific type, not only amongst the lower but also amongst the higher orders of being, than we have heretofore been inclined to allow. I allude to the reciprocal action of physical and vital forces.' (On the Value of the Distinctive Characters in Amœba. By the same author. *Annals & Mag. Nat. Hist.*, Aug., 1863.)

'It is only necessary to watch a specimen of *Amœba* carefully to become convinced that the appearance of a returning as well as an advancing stream is illusory. The stream, it will be observed, is invariably in the direction of the preponderating pseudopodial projections. The particles simply flow along with the advancing rush of protoplasm. There is no return stream, but only the semblance of one engendered by one layer of particles remaining at rest while

\* The conclusion here arrived at and the facts on which it is based have very recently been published as new and original by Herr Grüber. (See *Journ. Royal Micr. Soc.*, April, 1885, pp. 260-1.)

another is moving past them. In short, the effect is similar to that which would be produced were a transparent bladder or caoutchouc sac, containing granular bodies of greater specific gravity than the viscid fluid within which they were sustained, to be slowly rolled along a plain surface. In such a case it is obvious that only the granules on the upper or free aspect of the sac would be carried onwards, and that, having arrived at the most advanced point, they would be deposited (by their own weight) and remain stationary in common with that portion of the sac on which they rested, until the rest of the mass should again have flowed over them, causing them now to appear at the posterior extremity, when they would once more be carried along as before.

\* \* \* The essential attributes of sarcode, namely extensibility and contractility, coupled with the polymorphism evident in every example in which definite form is not partially maintained by the presence of a shell or test, necessarily involve the power of retracting as well as projecting these processes. Whereas the tenacity of the substance is not such that a pseudopodium once projected can be retracted toward the body in the same way that a piece of rope thrown forwards from a given point can be hauled in again, inch by inch. In the broad pseudopodium of *Amœba*, as also in the attenuated filaments of the Foraminifera, or the still more subtle filaments of *Acanthometra* or *Englypha*, the process is the same, and is brought about by a reciprocal outward and inward flow of the sarcode substance; and thus the granular particles are merely the passive exponents of a vital force which acts quite independently of them. For these reasons I would still regard the circulation of granules in the rhizopods as a pseudocyclosis, analogous, I grant, in appearance, but not in origin, to the cyclosis observable in certain vegetable cells, as, for example, in *Tradescantia*.\* (Further

Observations on the Distinctive Characters and Reproductive Phenomena of the Amœban Rhizopods. By the same author. *Annals and Mag. Nat. Hist.*, Nov., 1863.)

‘It is deserving of special notice, moreover, that the facility with which coalescence takes place between the pseudopodia, and the adhesive faculty of the ectosarc, are such mutually dependent conditions as to be inseparable. In *Lieberkuhnia*, the Foraminifera, and the Polycystina, these characters are at a maximum. In *Amœba* they are at a minimum, and consequently denote the closeness of the relation existing between the degree of differentiation, as thus manifested, and the presence or absence of a true nucleus and contractile vesicle. The higher the degree of differentiation, or, in other words, the higher the grade of the organism, the more completely does *Amœbosis*\* take place in it. In *Amœba*, which occupies the highest position amongst the true rhizopods, the distinction between the external and internal portions of the sarcode-substance is at a maximum, and hence there exists an opposite condition to that present amongst the Herpnmata (the lowest order of rhizopods in my classification), and we meet with the smallest amount of inclination to coalescence, and the least degree of adhesive viscosity in the ectosarc. Lastly, and equally worthy of note, is the fact that the lower the degree of differentiation of the sarcode-substance, the more distinctly is the pseudocyclosis of granules observable, and the more completely does it approach, and even involve, the immediate surface of the pseudopodia; being dependent as already shown, not in an inherent faculty of the protoplasm to circulate, but on the inherent contractile power of sarcode, by means of which, a con-

\* The term applied by me to denote the reciprocal convertibility of endosarc and ectosarc. As stated in another paper, it is singular that the word ‘*Amœbe*,’ from which the generic name *Amœba* is derived, signifies reciprocity or return, and yet that the true significance of the phenomena should not have been recognized.



stant interchange takes place between the interior mass and the external layer, and an equable distribution of nutritive material is secured in the bodies of the most rudimentary and testaceous types. When it is borne in mind that in none of the families of rhizopods is the circulation uninterrupted, and that it not only continually varies in rate, but frequently ceases altogether for a time, it will, I think, be allowed that any analogy between the phenomena and a special circulatory force is altogether discountenanced.' (Further Observations on the Distinctive Characters, Habits, and Reproductive Phenomena of the Amœban Rhizopods.' By the same author. *Annals and Mag. Nat. Hist.*, Dec., 1863.)

Lastly, the results already referred to 'could not take place if the two phenomena, namely, the vital contractility of the protoplasm itself and the circulating force by means of which the granules are impelled, acted independently one of the other. Did they act independently, any cessation or alteration in the one would not necessarily involve a cessation or alteration in the other, but the circulation of the granules would continue unchecked even when the protoplasmic mass had attained a state of perfect rest. And, notably, when the direction in which the protoplasmic mass had for a time been moving became suddenly reversed, the direction of the granular movement would remain unaltered, at least for a period, were the force producing it an independent one. But the direction which the granules continue to take under these circumstances almost immediately becomes reversed likewise, proving thereby that it simply follows the direction which has been imparted to it by the protoplasm. It only remains to be stated that these results are observable whenever a fresh pseudopodium is projected; every modification in the direction taken by the current of granules being distinctly referable to some corresponding change in the

form assumed by the protoplasmic body generally.' (On the Rhizopods as embodying the Primordial Type of Animal Life. By the same author. *Monthly Microscopical Journal*, April, 1869.)

LONDON, August 12th, 1885.

### The Actinic and Visual Focus in Photo-Micrography with High Powers.\*

BY JACOB D. COX, LL. D., F. R. M. S.

We find it commonly said that whilst the difference between the visual and the actinic focus is considerable when making photo-micrographs with low powers, it is not appreciable when using high powers. My experience does not accord with this statement, and some notes upon my own experiments may have interest to others.

If the statement had been that a sharp picture may be taken when the object is exactly in focus with a high power, I should not take exception to it, and I incline to think that this is what has been meant. But a sharp picture may be either a positive or a negative of the visual image seen in the microscope, and in my own work so many examples have turned out to be positives when I expected them to be negatives, that I have been led to make an investigation of the subject, in which the evidence tends strongly to show that with our best high power lenses the image fixed upon the sensitized plate is a positive instead of being a negative, and consequently the paper prints from this are negatives and not positives.

It would be very easy to overlook this difference in a large class of micro-photographs, because, in an alternation of dark and light lines, or dark and light spaces, it often matters little which of a pair is light or dark; the picture may be equally clear and satisfactory either way. In the case of a large majority of the microscopic objects photographed, either the posi-

\* Read before the American Microscopical Society.  
Revised by the Author.

tive or negative image would be good enough for the purpose intended: so good that a close examination of the point I am now suggesting would hardly occur to one. This, in fact, was my own experience until, in efforts to get a good picture of the broken edge of fragments of the finer diatoms, my attention was arrested by the fact that the appearances seen by the eye were often reversed in the print from the supposed negative which I had taken. As, in dealing with minute areolæ this often amounted to showing a projection where I had seen an apparent depression, and *vice versa*, it became in effect a failure to photograph what I had seen, and challenged my best efforts to overcome the difficulty. If the illumination of such transparent objects as diatoms were always by a perfectly central beam of parallel rays of light, there would be no practical difference whether they showed light upon a dark ground, or the reverse. But we rarely get such exactly central illumination, even after our best efforts to do so. For example, plate No. 23 of my broken shell series was thus taken with light intended to be strictly central, a diaphragm being behind the achromatic condenser, which had a small circular hole in it, limiting the illuminating rays to the small central portion of the condenser. Yet in one position the central areolæ of the *Coscinodiscus* which it represents, appear as deep cups, whilst, if it be turned around so as to change places of top and bottom, they appear as projecting bosses.

No. 51 of the same series was the first in which I distinctly marked in my note-book the fact that the dots in that diatom, *Mastogloia angulata*, appeared dark in the instrument, but light in the photograph print. The difference of effect was least important in shells which are an even, smooth film of comparatively little thickness, and greatest in those in which the diatom seems to have strongly marked bars separating the

lines of areolæ, as in *Pleurosigma Balticum*.

In a number of cases in which the plates were originally taken with a sharp focus upon the view of the shell which I desired, I have taken transparencies from them by contact, and using these last as negatives from which to print the paper prints, I have found that these last are, according to my notes, what the former should have been if there were no difference between the visual and the actinic focus. A few of these have been prepared for exhibition to the Society. The prints taken from the second plates are marked 'positives' of the originals, and are in fact the true representation of the object as I saw it when taking the original photograph. They are, No. 66, *Navicula serians*, Kutz., taken with a Spencer  $\frac{1}{16}$  objective, balsam angle  $125^{\circ}$ , with No. 118 as the positive from it.

No. 60, *Pleurosigma Formosum*, W. Sm., taken with a Spencer  $\frac{1}{16}$  objective, balsam angle  $108^{\circ}$ , with No. 122 as the positive from it.

No. 83, *Pleurosigma Formosum*, W. Sm., taken with a Whales  $\frac{1}{16}$  objective, balsam angle  $82^{\circ}$ , with No. 119 as the positive from it.

No. 110, *Pleurosigma Balticum*, W. Sm., taken with a Zeiss  $\frac{1}{18}$  objective, balsam angle  $116^{\circ}$ , with No. 113 as the positive from it.

The objectives are all of the first class, and it is safe to assume that what holds true with them will be found true with any of our best glasses.

In taking the original photographs, I used a plain plate of glass instead of the usual ground glass screen in the camera, and focussed by the aid of a Dorlot focussing glass.

The examples to which I have referred would seem to warrant the conclusion that in using high-power objectives the difference between the visual and the actinic focus is the equivalent of that between a positive and negative image of the object, when the details have passed a certain limit in fine-



ness. But some experiments, made for the purpose of finding how far the tube of the microscope must be moved to secure the proper actinic focus upon the sensitive plate, have had such unsatisfactory results as make me unwilling to venture any positive conclusion, but content myself with stating the facts above given, until further investigations which I am making shall be completed.

In the course of the experiments referred to, I noticed that the image taken on the plate was apparently of a lower plane in the object than the visual one which I was seeking to get. This was shown in the diatoms with a convex surface, by the sharper image, in the print or plate, of areolæ nearer the margin of the object than those upon which I had focussed. It showed also that the difference seemed to be the same in kind as in the use of low power objectives, with which it is necessary to raise (withdraw) the tube after getting a sharp visual image of the object. Acting upon this, I tried in several instances the gradual raising of the tube, taking pictures at slightly varying departures from the visual focus, until the image was quite spoiled and blurred to the eye. I made some series of as many as five or six plates, thus progressively varying, but without satisfactorily establishing any point (different from the visual focus) at which the objective should be placed to secure in the photographic image the true characters of the visual one. I was surprised to find at what a distance from the visual focus a sharp image could be taken, but it was not the image for which I was in search. Examples of this sort are among the prints which I will exhibit to the Society.

I design to add to my experiments on the subject, the examination of the effect of changing the focus of the focussing glass to correspond with the difference between the visual image of a diatom showing light dots or areolæ and that which shows dark ones. Everybody has noticed that a

slight change of focus with a high power produces this change of appearance, and if the focussing glass were adjusted for the image which is complementary to the one desired and then the focussing done in the usual way, the result might be that which is sought. It has at least seemed worth the experiment, but a press of other work has prevented my making a satisfactory test of it before the time of our meeting.

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### American Society of Microscopists.

On the second day the proceedings were opened by some remarks by Dr. Detmers on the poisonous dried beef which caused violent sickness in Momence, Ill., some time ago. Dr. Detmers found abundance of bacteria in the specimen he examined.

Dr. Thomas Taylor demonstrated his methods of distinguishing fats with the microscope. This subject attracted considerable attention and a committee was appointed to examine the processes and report upon the results. The committee was first composed of Dr. Fell, Dr. Detmers and Mr. Vorce, but Dr. Curtis and Mr. Atwood were afterwards added. The work done by the committee before separating indicates that Dr. Taylor's methods are reliable. The members of the committee are individually at work on the subject. The method of observation was described in these columns last month.

Mr. J. Kruttschnitt presented a paper entitled 'Pollen Tubes Again.' This was followed by a contribution by Dr. Lester Curtis describing the method of cultivating micro-organisms. Dr. Curtis' method is to take a good potato, clean and boil it, being careful to get a potato that is not mealy. The potato is then immersed in a solution of corrosive sublimate. A scalpel is heated to a red heat and laid edge upward, as the bacteria which continually float in the air are less liable to attach themselves to the sharp edge than to the side or back

of the knife. The potato is carefully cut and the matter containing the germs spread over the cut surfaces. Then the potato, which must be carefully handled by a hand immersed in corrosive sublimate mixture, is placed on a blotter under a glass dish. The hand that touches the potato must be allowed to come in contact with nothing else until the operation is finished. Bacteria thus carefully planted will grow amazingly.

Professor H. L. Smith then spoke on 'Some Formulæ for Highly Refracting Media for Mounting,'\* and described a simple instrument for testing homogeneous immersion fluids. (See page 181.)

Dr. L. M. Eastman then read a paper on 'Fatty Infiltration of the Liver,' which was discussed.

A paper by Professor W. A. Rogers, 'The Measurements of Eight Rowland's Gratings at 62° Fahr.' was read by title. Prof. Burrill presented a paper on 'Uredineæ of Illinois.'

A paper by Mr. Gundlach, 'Immersion Objectives,' was read by Mr. H. A. Turner, and Professor Kellcott read by title a paper on 'Some Fresh-Water Infusoria, with Descriptions of a Few Species Regarded as New.'

On the third day Professor S. H. Gage made some remarks on the blood-corpuscles of *Necturus*, which led to some discussion. Two papers by Dr. M. L. Holbrook, 'First Development of Muscle in Embryos of Chicken and Man,' and 'Studies on the Development of Cartilage in the Embryos of Chicken and Man,' were read by title. Dr. A. H. Tuttle spoke briefly on tumors in the mammary gland of the lower animals. Mr. Dutton, of Chicago, made a short speech in regard to the need of a publication devoted to microscopic subjects, and offered the following resolution:—

*Resolved*, That a committee be appointed by the chair to report upon the advisability of publishing a quarterly microscopic journal, to be pub-

lished by the American Society of Microscopists.

The idea involved in this resolution did not seem to be regarded favorably by many of the members, and it was lost, although the vote was close.

A committee was appointed whose duty it was to select names for officers of the society for the ensuing year and report to a subsequent meeting.

The afternoon was taken up with the working session at Le Grande Rink. Perhaps we can do no better than to quote directly from the *Plain Dealer* the account of this meeting, which, although not strictly such as 'our special correspondent' would write, is sufficiently suggestive of what was to be seen:—

'It is not the purpose of this article to treat of the exhibits for the benefit of microscopists alone but to publish matters of interest to the laity as well. At one table were some wonderful micrometers. Rulings away up beyond the 150,000th of an inch were shown. One man, Professor Rogers of Cambridge, has won a wide reputation for the accuracy of his rulings of standards of fine measure. Dr. Fell, of Buffalo, showed a platinum-iridium plate that had been ruled and adopted as the standard of microscopic measurement. The unit of measure is the millimetre, which on the plate is divided and subdivided until a powerful microscope is required to see the delicate lines. This plate, which looks so valueless to the uninitiated, is so highly prized that it is allowed to go out of the hands of Dr. Fell, who is treasurer of the American Society, only upon a resolution of the society. It is proposed to secure copies of the delicate measure in the future as soon as possible. There are not five men in the world who could prepare even an approximate duplicate, the making of which requires the most delicate machinery and carefully prepared metals. An extremely cold or hot day would make a vast difference with a standard not prepared with the utmost care.

\* See this Journal, current volume, page 181.



'At another table a delicate apparatus was cutting a tumor into slices so thin that sharp eyes were required to see them. The keenest razor is a dull and clumsy edge compared with the blade of the delicate knife that was slicing the tumor, producing specimens to be mounted.

'A gentleman from Newark, O., had at one of the tables an apparatus for freezing specimens in order that they may be the more readily sliced. He froze a kidney firm as a rock before the eyes of the visitors. Then he took the lower jaw of a mole and ground it down, teeth, flesh, and all, several degrees thinner than the most delicate tissue paper. Not a tooth fell out of place in the operation.

'Professor Walmsley, of Philadelphia, well known to all microscopists, exhibited an apparatus for taking the photograph of anything, from a diatom to a bug. A little insect smaller than the period at the end of the preceding sentence loomed up when photographed larger than the top of a frying-pan.

'Nearly all the instruments were illuminated with little brass lamps, but some of the exhibitors were shown specimens by the light of electricity.

'Dr. James, of St. Louis, with a simple device, was mounting specimens rapidly.'

Dr. A. Y. Moore showed *A. pelucida* resolved by a Gundlach half-inch objective with an auxiliary lens attached in front (as first done by Mr. Wenham), which converted the objective into an immersion with a power midway between a  $\frac{1}{3}$ - and a  $\frac{1}{4}$ -inch. Mr. Spencer was present with a new  $\frac{1}{15}$ -inch of his own make, and the resolution was tested by that, and decided to be true, the lines being 96 to 0.001 of an inch. A photograph of this valve is to be made for the purpose of accurately counting the striæ.

The exhibit of photo-micrographs by Mr. Vorce was one of the finest and largest ever seen. There were

about 350 prints from fourteen different workers.

Among other interesting demonstrations at the working session may be mentioned the following:—

The use of the micro-spectroscope and its application to original research, by Lee H. Smith.

The use of the polariscope in original research, by J. D. Hyatt.

Photography and its applications as an aid to research. Photo-micrography by lamplight, by William H. Walmsley. Gelatino-bromide enlargement by lamplight, and photo-micrography by sunlight, by Robert Dayton.

Micrometry. Expositions of methods, by George E. Fell, M. D.

Staining tissues in mass, simple and compound stainings, by A. H. Tuttle.

Staining sections, simple and compound stainings, animal sections, by L. M. Eastman.

Practical demonstration of the relation of aperture to power in microscope objectives, by Allen Y. Moore.

Special methods of cell making, cementing, etc., by Rev. T. J. Brownell.

The preparation and application of cements, formulas, etc., by Frank L. James.

In the evening the soirée was held, which is thus described by the *Plain Dealer*:—'It was a unique entertainment and attracted over fifteen hundred persons, including ladies and gentlemen of prominence. A more satisfactory place for holding the soirée could not have been selected. The success of preparing the affair largely depended on the exertions of the following soirée committee:—Chairman, C. M. Vorce; R. Dayton, M. D.; F. O. Nodine, M. D.; A. Y. Moore, M. D.; J. R. Owens, M. D.; M. Rodgers; John Sawyer.

'As usual at such gatherings certain tables were centres of intense interest. The crowds around these tables were so great that it was with difficulty that one could get near them.

'H. E. Summers, of Ithaca, N. Y., has a curious looking animal lying under a rag with its gills in range of the microscope. He kept it still, and one could see through the glass the wonderful sight of the blood swiftly circulating. The animal was a hideous looking affair, sometimes called by the wicked name of "hell bender." Next to it was a microscope showing the circulation of the green matter in a peculiar growth. R. N. Reynolds, of Detroit, shows specimens of grass from the Detroit river in which the circulation can be plainly seen.

'Mr. Reynolds had a most important exhibit. Few persons have an adequate idea of what lively stuff printers' paste is. Mr. Reynolds obtained a specimen from the paste barrel of the *Detroit Post and Tribune*. Having looked at the wriggling worms that made the mass literally alive one could understand why it is that newspaper paste so seldom sticks. The insects literally walk off with the pasted clipping on their backs.

'Mr. G. W. Stockley, of the Brush Electric Company, had an attractive table. He is a temperance man, and that too in the face of the fact that Lake Erie water that people in this city have to drink is liable to contain specimens of the *Rotifer vulgaris*, which he exhibited.

'Dr. Thomas Taylor, of Washington, showed samples of butter. The microscope reveals the peculiar cross that the doctor says characterizes the fat. He declares that it is a St. Andrew's cross, a trade-mark as it were from nature to distinguish it from adulterated compounds that never show the cross. Specimens of pure lard were also shown and also of butterine, which, under the glass, looks as little like butter as ink resembles limpid water.'

The program of the exhibition is too long to reproduce here. Looking over it we find many familiar names among the exhibitors, and many objects not often seen at exhibitions.

There are one hundred and fifty-nine objects on the list.

On Friday morning, the last day of the meeting, the officers for next year were nominated and elected. They are as follows:—President, T. J. Burrill, of Champaign, Ill.; vice-presidents, Dr. F. S. Newcomer, of Indianapolis, and W. J. Lewis, of Hartford; executive committee, Dr. L. F. James, of St. Louis, John Kruttschnitt, of New Orleans, and E. H. Griffith, of Fairport, N. Y. The secretary was instructed to cast the ballot of the society for these gentlemen.

A resolution was adopted thanking Professor C. M. Vorce, of this city, for his efforts in behalf of the society. Judge J. D. Cox then made the following remarks:—

'Mr. Chairman, the custom of giving our retiring officers a vote of thanks is a good one, but there is some danger that it may become too formal. Our president, whose necessary absence this morning we regret, has not only discharged his official duties with ability, courtesy, and dignity, but I know I speak the feeling of the whole society when I say that it has been a constant delight to us to have him in our midst, and that we have constantly followed him with our warm affection as well as our heartfelt respect. We all earnestly hope he may many years be spared to lead us in everything which pertains to microscopy, and to raise the character of our deliberations by the wisdom and sweetness of his influence. In this spirit I move that the most hearty thanks of this society be tendered Professor Hamilton L. Smith for the manner in which has discharged the duties of the presidency during the past year.'

Dr. Lucien Howe, of Buffalo, read an interesting paper on the imperfection of the eye and test objects. This paper was discussed by Dr. Newcomer, who said that no two persons' eyes are the same; that we ought to consider astigmatism.



James E. Whitney's paper on 'Rapid Section Cutting' was read by title only. Dr. Manton's paper on preparing chicken embryos for the microscope was listened to with much attention. Mr. Hudson recommended the incubator as preferable and more regular than the hen.

Judge Cox's paper on 'Some Diatom Hoops' was carefully described and illustrated on the black-board.

The society received a communication urgently requesting that the meeting next year be held at Chautauqua. It was referred to the executive committee.

Dr. Detmers, in speaking of the value of such gatherings of microscopists referred to the importance of reliable microscopical evidence and cited an interesting case recently on trial in Illinois where a murder was committed in an old ice-house. The murdered man was found lying on a pile of pine sawdust. A man was arrested for the murder upon whose boots and pantaloons small particles of sawdust were found clinging. He claimed that he had not been near the ice-house where the murder was committed, but had been sleeping in another ice-house several yards away. It was conclusively shown that all the sawdust in the house where he claimed to have been was from hard wood. There was no hard wood sawdust in the house where the murder was committed. Particles of sawdust from the prisoner's boots and clothes were placed under the microscope by an expert, who conclusively proved that it was pine sawdust, exactly like that found at the scene of the murder. The microscopist's evidence led to the conviction of the prisoner.

The closing session was devoted to the reading of a few papers. H. E. Summers presented a paper on a new method of making a cabinet. C. M. Vorce, of Cleveland, read a paper on a combined focussing and safety stage for micrometry with high powers, and James H. Logan, of Pittsburg, on a new life slide. Professor

Burrill talked about a new heliostat.

Treasurer Fell announced that the Royal Microscopical Society had given five guineas toward the Tolles and Spencer fund. It is proposed to build up an endowment, the proceeds of which shall be used in the way of prizes toward encouraging original research in microscopy.

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## EDITORIAL.

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**Publisher's Notices.**—All communications, remittances, exchanges, etc., should be addressed to the Editor, P. O. Box 630, Washington, D. C.

Remittances should be made by postal notes, money orders, or by money sent in registered letters. Drafts should be made payable in Washington, New York, Boston, or Philadelphia.

Subscription-price before April 1st, \$1 per year, in advance. All subscriptions begin with the January number. After April 1st the subscription-price will be \$1.50.

The regular receipt of the JOURNAL, which is issued on the 15th of each month, will be an acknowledgment of payment.

The first volume, 1880, is entirely out of print. The succeeding volumes will be sent by the publisher for the prices given below, which are net.

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Vol. V (1884). Nos. 2-12, \$1.00.

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**POSTAL CLUB BOXES.**—The boxes were started on their circuits from Troy on the 15th of last month. The plan of operations is the same as last year. Members should remember that new boxes to be filled will be sent out, probably in January, and they should be prepared to fill them with good specimens.

Box F contains the following specimens:—

1. Garden pea. W. C. Gorman. A vertical section of the germ, showing radicle and plumule, and cells stored with starch.

2. Sea mat, *Canda* sp. Miss Grace E. Edwards.

3. Group of diatoms, *Arachnoidiscus ornatus*. F. J. Seidensticker.

4. Gypsum crystals. C. M. Burgess. From copper queen mine, Arizona, supposed to be colored by copper.

5. Finger of monkey. Prof. Arthur B. Morrill.

6. Young horse-shoe crab. M. S.

Wiard. Mounted in glycerin. Mr. J. D. King writes:—'If these had been soaked in liquor potassa, followed with alcohol and glycerin, and mounted in a medium colored with eosin, they would have been both transparent and beautiful.'

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### NOTES.

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—The best set of plates illustrating the diatoms is undoubtedly those of Schmidt's 'Atlas der Diatomaceen-kunde,' a large quarto work, of which 22 parts have been published, embracing about 88 fine plates. A set of these plates is now offered by a reader of the Journal at considerably less than cost, and any reader who may wish to purchase the set may write to the Editor for further information. The actual cost of the plates as received is \$49.28.

—Mr. W. J. Simmons, in a communication to *Science Gossip*, describes a diatom in the fresh-water canals of Calcutta, which resembles in its form and manner of progression the *Bacillaria paradoxa*. The same diatom has also been found in the Lehigh River at Bethlehem, Pa., by Rev. Francis Wolle. It appears, therefore, that the species is not absolutely confined to brackish water.

—We have received six very fine mounts of vegetable and animal preparations from Mr. Arthur J. Doherty, of Manchester, England, who has recently offered sections cut and stained ready for mounting, on one of our advertising pages. The sections are evenly cut and stained perfectly. An excellent opportunity is thus offered to microscopists to obtain first-class sections for mounting. The specimens received include sections of human spleen, ovary of *Rhododendron ponticum*, root of *Rubus fruticosus*, and leaf of *Ficus elastica*.

—We have received from Mr. A. B. Leckenby, of Rochester, a combination of a pencil case and a microscope, which he has devised for the use of school children in the study of botany. It consists of a thin tube of brass to hold the pencils, at one end of which is a lens mounted in such a way that when drawn out of the tube it is a simple microscope, well adapted for studying seeds and parts of plants, insects, etc. In addition to the microscope pencil case, Mr. Leckenby has prepared sets of fifty slides of seeds,

neatly mounted on stiff paper, to accompany it. The case and sets of seeds will be a source of pleasure and instruction to children, and also to persons more advanced in life, for this little microscope can reveal a world of beauty.

—*Entomologica Americana* is an excellent monthly magazine covering the whole field of entomology, published by the Brooklyn Entomological Society. It is a combination of the *Bulletin* of the Society and *Papilio*. The editor is Mr. John B. Smith, who is writing 'An Introduction to a Classification of the N. A. Lepidoptera,' now being published in the magazine.

—The report of the botanist of the New York Agricultural Experiment Station, Prof. J. C. Arthur, for 1884, has recently been published. It is a pamphlet of about thirty pages, and contains much interesting information concerning fungus diseases of trees. The production of gum on the limbs and trunk of peach, pear, and other fruit-bearing trees, and also upon the fruit itself, has received attention. The results of experiments indicate that the abnormal production of gum is caused by a fungus of some kind, possibly a bacterium, but more likely a filamentous fungus, not necessarily a single species. The observations recorded in the report indicate that a large field for investigation is open in connection with the fungus affections of trees, fruits, and vegetables.

—Dr. T. B. Redding has prepared a report of '*Trichina spiralis* and Trichinosis, including an examination of Indiana Hogs,' under direction of the Indiana State Board of Health. It seems to be mainly a compilation from other documents treating of the subject. There is, however, a valuable bibliography of the subject appended. The author examined 610 Indiana hogs and found 4¾ per cent. infected. Other observers found from 4 to 12 per cent.; about Lawrenceburg, of 245 hogs examined in 1875, 16½ per cent. were infected, but this seems to be an exceptionally infected locality.

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### Exchanges.

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[Exchanges are inserted in this column without charge. They will be strictly limited to mounted objects, and material for mounting.]

Diatomaceous clay from this place, and fine slides of Foraminifera, for fine slides, material or back numbers of A. M. M. Journal.

E. H. RICHARDS,  
Woburn, Mass.



# THE AMERICAN MONTHLY MICROSCOPICAL JOURNAL.

VOL. VI.

WASHINGTON, D. C., NOVEMBER, 1885.

No. 11.

## Photo-Micrography.—I.

BY THE EDITOR.

It is after considerable deliberation that we have decided to prepare a series of articles on this subject, the first of which is published this month. There are so many small and inexpensive but excellent manuals for amateurs and beginners in photography, that it has seemed in the past quite unnecessary for us to devote so much space to the subject as the proposed scheme will require. However, when we consider the special branch of photo-micrography as distinct from general photography, it will be seen that the literature is not so exhaustive or readily accessible as may at first appear.

It is customary to begin a series of articles like this with a general notice of the literature of the subject, but this we cannot do. Perhaps a review of what has been done in this connection may be prepared for a future article. Recent literature of the subject is well represented by Dr. G. M. Sternberg's book, 'Photo-micrographs and How to Make Them,' which is a useful book of reference.

We have been led to undertake the preparation of these articles in response to the expressed wish of some of our subscribers, and it is proposed to make them comprehend all the operations from focussing in the camera to finishing the silver print on paper, including also certain improved methods of treating negatives to correct imperfections. They will, therefore, afford the reader a complete treatise, embracing all the operations an amateur, either in photo-

micrography or field photography, is likely to undertake.

The subject will be treated in successive articles under the following divisions:—

1. General consideration of photographic methods.
2. Apparatus for photo-micrography.
  - a. Microscope and accessories, camera, etc.
  - b. Plates, chemicals, developing apparatus, dark room, etc.
3. Exposing the plate.
4. Developing the negative.
  - a. Ordinary process of development.
  - b. Correcting errors of exposure or development.
5. Making transparencies.
6. Making silver prints on paper.

With so much by way of introduction, we proceed to take up the first division of the subject.

### 1. GENERAL CONSIDERATION OF PHOTOGRAPHIC METHODS.

One of the first questions that will present itself to the beginner in this work is the kind of light to be used. If he begins to look through the photographic periodicals for information on this subject, the result may not be quite satisfactory. Very likely he will find an article by Maurice N. Miller, M. D., evidently an operator of experience, who thus expresses his views on this subject: 'The minor methods of lighting—by oil, gas, etc.—do not deserve any consideration at our hands at this time. We are engaged in the attempt to produce the very best results obtainable, and I know very well that no amateur is

going to be satisfied with silhouettes made with a dark lantern attached to a camera box.' Even the electric light is condemned by this writer, who says: 'The incandescent lamp is of no use, except as previously indicated, for very unambitious attempts with low powers.'

There is no mistaking the author's meaning in this regard. Nevertheless, we venture to express an opinion more or less opposed to his; for not only is it true that photographs of delicate objects of all kinds have been made, by artificial light, perfectly sharp and satisfactory in every way, but it is possible that lamp-light may be found in certain cases to be even better than sunlight. But the practicability of using artificial light is fully demonstrated by the excellent work of the Hon. J. D. Cox on diatoms, with powers of 1000-1500 diameters and more. Mr. W. H. Walmsley, who is also an experienced worker in this field, and who gave some eminently practical demonstrations of photo-micrographic work at the meeting of the A. A. A. S. last summer, which have been highly commended, will fully confirm the value of artificial light for this purpose. As for the incandescent electric light, we need only refer the reader to the work of Dr. Van Heurck, with powers of  $\frac{1}{12}$  or  $\frac{1}{18}$ -inch,\* and to the article on the Electric Light in Microscopy, published last year. (Vol. v, p. 222.)

It shall be our endeavor, in writing these articles, to make them eminently practical. Only well-tried and reliable methods will be given, and not one that the writer cannot fully recommend from personal experience with it. While we hope to make the directions and explanations so clear that any person can follow them and perform the operations, yet it is desirable that the beginner should spend some time in the developing room with an experienced operator to see the methods of working.

In order that the beginner may work intelligently it is advisable he should know something of the chemistry of photography. The sensitive plate is a piece of glass (or other material) coated on one side with emulsion. The emulsion is prepared by dissolving silver nitrate in a solution of gelatin in water, and adding thereto potassium chloride, bromide or iodide, or a mixture of these. The result of this addition, which must be made in a room lighted with ruby-glass windows, is to throw down, or precipitate, very finely divided particles of silver chloride, bromide or iodide, since these silver compounds are quite insoluble. These minute particles remain suspended in the gelatin. It is these minute particles that are sensitive to light, and from this time until the plate is exposed in the camera, and the picture is fully developed, the emulsion must be carefully protected from all except red light, to which the particles are not sensitive. The emulsion thus prepared is cooled, the gelatin solidifies, and is then thoroughly washed in water. It is then melted, flowed over glass plates set perfectly level, and allowed to dry, thus making a thin, hard coating which is the sensitive film.

The degree of sensitiveness depends upon many conditions, but primarily upon the silver compounds used. Thus the chloride is less sensitive to ordinary daylight than the bromide. The chloride is sensitive to blue and ultra violet rays, the bromide is also sensitive to green and yellow light, and the iodide has its special range of sensitiveness in the spectrum. Advantage is taken of these peculiarities for particular purposes, hence we have gelatino-chloride emulsions, gelatino-bromide emulsions, etc. The plates generally used for ordinary photographic work are made with bromide emulsions containing some iodide.

When such a plate is exposed to light in a camera, the particles of sil-

\* This Journal, current volume, p. 44.



ver chloride, bromide or iodide are changed in some way, not very clearly understood; where the light is strongest the change is greatest, and where it is weaker the change is proportionally less, and thus an image is impressed upon the plate, known as the invisible image, because it is only brought into view by the subsequent process of development. The image is not, however, absolutely invisible, for it can be seen on a plate that has been long exposed. The change produced by the light is not entirely understood, but the weight of evidence indicates that it is purely a chemical change. It is supposed to consist in a partial separation of the bromine, chlorine or iodine, as the case may be, from the silver. This change once effected is permanent, and plates may therefore be exposed at any time, and developed months afterward.

Coming now to the subject of development, it will suffice to say that a developer is a solution which completes and intensifies the action begun by the light. Thus, if we suppose the silver bromide is partially decomposed by the light, having lost a portion of its bromine, the developer removes the remaining portion of the bromine, leaving metallic silver, in the form of a black deposit. The quantity of silver thus reduced to metal in different parts of the film corresponds exactly to the intensity of the action of the light at those parts; hence, wherever the lights are brightest, we find the thickest and most opaque deposit of silver, and in those parts where there was least light—in the deep shadows of the picture—there may be no reduction whatever. Thus it is that what is light in the object is dark on the plate and vice versa; hence we designate the plate a negative.

The next operation, known as fixing, consists in dissolving from the film all the unchanged silver compound that is still sensitive to light. When this is done the negative has only to be washed and dried. It will

then consist of a film of gelatin retaining the metallic silver picture produced by light and development.

[To be continued.]

### The Magnifying Power of an Inch Objective.

Seeking to answer the question at the head of this note, reference was made to two or three catalogues with unexpected results. It must be understood that in all cases referred to, the standard length of tube and a two-inch eye-piece are supposed to be used.

So far as the data go, the inch objective has assigned to it magnifying powers ranging from 46 to 55 diameters. On computing the inch-value of objectives of higher and lower power, the same data being used, the differences expand and the extremes are 36 and 60 diameters. These figures require no comment.

The system of nomenclature recommended by the committee on eye-pieces of the American Society of Microscopists will no doubt soon be universally adopted; why cannot a similar committee be got to settle the standard value of an objective, which, with standard length of tube, and a two-inch eye-piece, shall have a certain magnifying power and be called a one-inch? To this standard it will be necessary to fix limits of deviation to meet the mechanical difficulty in making systems of lenses with precisely the same magnifying power:—from this standard inch, all other objectives can have their standards calculated and their limits of deviation decided.

These suggestions are made in the hope that microscopy may be placed in possession of standardized tools, whereby its results may approach as closely as possible to precision and uniformity. Owing to the defective nomenclature now in use, much confusion and not a little nonsense is frequently presented.

In the following table the power of the inch is taken at 50, supposing a

single lens of that focal length to magnify 10 diameters. Of course the value of such an arrangement depends on its authority. The table was made for my personal convenience, and I send it solely for the purpose of giving a better idea of what I have in mind.

A tube of standard length (ten inches) and a 2-inch eye-piece are to be used in all cases where this table is referred to.

<i>Focal Length.</i>	<i>Limits of Variation.</i>	<i>Linear Magnifying Power.</i>	<i>Limits of Variation.</i>
4-in. 4.000	3.750	12.50	13.39
3½ 3.500	3.250	14.28	15.47
3 3.000	2.750	16.66	18.33
2½ 2.500	2.250	20.00	22.60
2 2.000	1.875	25.00	26.78
1½ 1.750	1.625	28.57	30.95
1¼ 1.500	1.375	33.33	36.66
1¼ 1.250	1.125	40.00	45.00
1 1.000	.9375	50.00	53.57
¾ .8750	.8125	57.14	61.90
¾ .7500	.7016	66.66	70.83
⅔ .6666	.5893	75.00	87.50
⅔ .5000	.4687	100.00	107.14
⅔ .4375	.4187	114.28	119.64
⅔ .4000	.3666	125.0	137.50
⅔ .3333	.2916	150.0	175.00
⅔ .2500	.2250	200.0	225.00
⅔ .2000	.1833	250.0	275.00
⅔ .1666	.1547	300.0	325.00
⅔ .1428	.1339	350.0	375.00
⅔ .1250	.1180	400.0	425.00

—O— W. M.

### Rotary Object Carrier.

BY J. M. FLINT, SURG. U. S. N.

The following described device for exhibiting a series of mounted microscopic objects, without the inconvenience of a change of slides, though probably not entirely new (few things are so), is yet original so far as the writer is concerned, and has been found efficient in practice. As described it is arranged for showing foraminifera, which are viewed

as opaque objects, with a low power. The selected foraminifera are mounted on small brass disks furnished with a stem, by means of which they may be carried in a 'Beck's disk holder' when it is desired to make a thorough study of the specimens.

Ordinarily these disks are inserted in thin wooden slides of regulation size and kept in the usual boxes made for the purpose, until the series is complete or ready for transfer. In order to protect the specimens from dust or injury, and at the same time maintain their accessibility, movable covers are constructed and secured as follows:—A score or more of curtain rings, not flattened, are slipped upon a squared rod of wood, and brushed over freely with thick shellac. On the following day, before the shellac has become hard, the rings are slightly separated in pairs. When the pairs are firmly united, a thin glass cover is secured to the upper surface of each pair, and thus a little box cover is formed, deep enough to enclose disk and specimen. Now, by driving two small gimp tacks into the wooden slide, at the proper distance apart, and deep enough so that the heads of the tacks will just enter the groove between the rings, a simple catch is formed, by means of which the cover may be secured, and also be removable at pleasure.

For exhibition—and for convenience of reference as well—these disks, bearing the specimens and the covers, are transferred to a thin circular plate six inches in diameter, in this case made of three or four sheets of card-board glued one upon the other. This makes a firm plate, not liable to warp, and in which holes may be readily bored for the insertion of the disks, and the tacks driven to secure the covers. By inserting the disks as near the edge of the plate as possible, a line fifteen or more inches in length is obtained on which to display the objects. The circular plate bearing the specimens as above, is made



to rotate upon a pivot passing through its centre in such a way that the objects are brought successively into the field of the microscope.

The manner of support of this pivot and its attachment to the stage of the microscope must depend upon the instrument used, which, however, should have a stage with mechanical movements, and the attachment be made to the upper stage-plate, thus giving control of each object when brought to the field, in the same manner as if it were mounted upon the ordinary slide. The writer, having a Beck's first-class stand, constructed a pivot support out of a piece of thin board (cigar-box), two inches wide and three inches long, the pivot being a common wood-screw inserted near one end, and carrying a wooden nut to steady the revolving plate, and the attachment to the stage-plate being effected by means of four small screws driven nearly home on the under side of the thin strip bearing the pivot, the heads of the screws being so arranged that they slide into grooves on the stage-plate, which ordinarily carry one of the clamps for securing the object slip. A more elegant, but not more efficient, support of brass has since been obtained of the instrument maker.

Shallow notches made with a round file on the edge of the revolving plate, into which drops the curved end of a light spring serve to inform the observer when the object is in the proper position in the field. The space within the circle of object is utilized for labelling the specimens.

Though requiring much verbiage for a description which may still seem not very clear, the apparatus is really very simple, and was entirely constructed by the writer out of materials at hand. Designed solely for the purpose mentioned—the exhibition of foraminifera—yet with slight modifications it seems capable of serving a more general purpose. Transparent objects might be mounted on small squares of glass, made

transferable from wooden or glass slips to the revolving plate as above, the necessary holes being made in the plate to allow the passage of light from below.

The convenience of such an arrangement is obvious, whether for exhibition of objects to the unskilled (the only manipulative skill required on the part of the observer being adjustment of focus), or for personal reference and comparison, a series of specimens being examined in this way as readily as if they were plates in a bound volume.

U. S. FISH COMMISSION STEAMER  
ALBATROSS,

July 30th, 1885.

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### Bausch & Lomb Microtome.

A short time ago we had an opportunity to examine and use one of the microtomes recently introduced by the Bausch & Lomb Company. The results of our short trial were eminently satisfactory, and we take pleasure in presenting our readers with an illustration of the instrument this month. It is not so elaborate as some of the foreign devices, which are no more efficient, so far as we are able to judge. Some minor improvements have been made since the cut was prepared, to facilitate the removal of the pan and in the movement of the block which carries the knife. It will cut successive sections without interruption  $\frac{1}{1500}$  to  $\frac{1}{2000}$  of an inch in thickness. We can do no better than give the description of the makers, which is as follows:—

‘The base, curved arm, upright and v-shaped beds are made of one continuous casting, thus insuring extreme rigidity, without excessive weight. The knife-carrying block is fitted in the angular way and rests upon five points; this latter feature insures the least friction and consequent ease of movement with the greatest stability, and is the nearest approach to a perfect plane. Contained in the block is a spring which

bears against a projecting flange on the upper end of the v-shaped bed, so that no matter how hard the material may be, the knife moves steadily through it without deviating from its plane and without requiring any extra pressure. The upper surface is provided on its entire length with

straight or very oblique cut, the carriage with object may be placed at such a point where it is the most convenient in its relation to the cutting edge.

To the carriage are directly fitted the micrometer screw with graduated disk and a slide which is acted upon

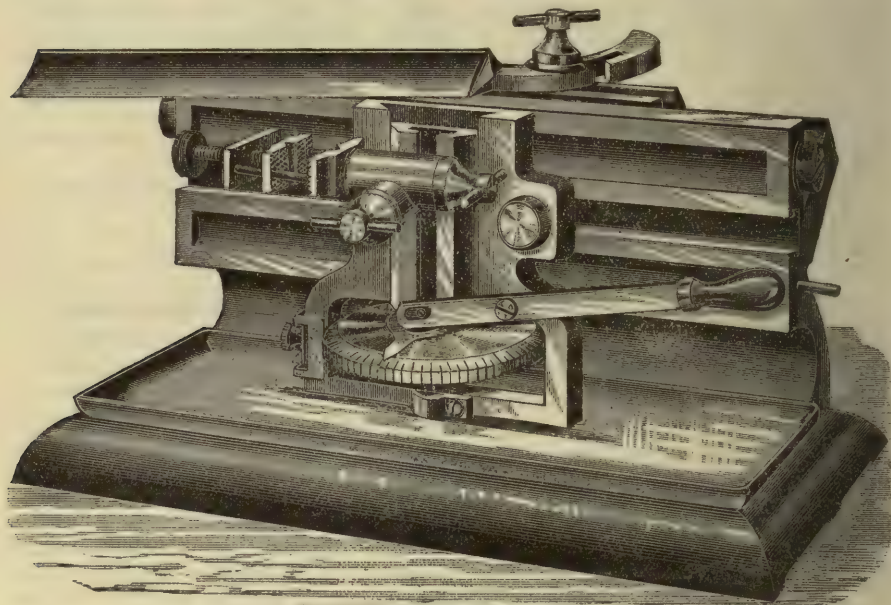


FIG. 30.—Bausch & Lomb Microtome.

a grooved slot, to which is fitted a sliding thumb-screw, so that the knife may be fastened at any point upon it.

The knives, which are specially made for these instruments, have a curved arm with slot, so that any part of the cutting edge may be used; they are made of the finest steel and are guaranteed. Stop-screws with soft rubber cushions are fastened at the ends of the angular way.

The front vertical bed is planed and polished and is arranged with a grooved slot its full length. The adjustable carriage is fitted to it and may be securely fastened at any point upon it by means of two heavy screws. The tightening pin for these, when not in use, has a receptacle in the solid bed. It will thus be seen that, whether it is desired to make a

by the former. A provision is made for taking up the possible wear on the screw. At one side of the carriage a spring is attached which works in the grooves on the edge of the disk with a pronounced click, so that the feed may be controlled without watching it; this may be loosened, so that it will not act, when it is desired to use the index only. A lever with ivory handle is connected with the slide, so that this may be returned after the screw has come to the limit of its motion.

The slide is provided with a grooved slot, which admits of the quick adjustment of the universal joint and clamp for specimens of different lengths. The universal joint permits inclination in any direction and the clamp will receive objects up



to one inch diameter. A nickel plated drip-pan is fixed to the upper surface of the base.

'The solid portions of the instrument are japanned, while those which come in contact with the hands are highly polished and nickel-plated.'

Two sizes are made, for \$40.00 and \$47.00, respectively, complete with knife. A still cheaper form of microtome, designated the Student's Microtome, is made by the same company for \$32.00.

### On the Precise Relations of Micro-Organisms to Disease and the Science of Disinfection.\*

BY CHAS. T. KINGZETT, F. I. C., F. C. S.

While the connection of micro-organisms with the chief contagious fevers is, as yet, a matter of pure inference, it is impossible, in the face of the results of modern investigations, to deny the intimate relations of micro-organisms to certain other diseases, including puerperal fever, pyæmia, septicæmia and anthrax of cattle; but of the nature of the precise relations next to nothing is known. The physiological effects produced by inoculation experiments can be readily observed, but the physiologist can not lay his hands upon the active principles which cause them. In this connection, I am convinced he can ascertain nothing of a final character without the aid of a chemist; and because this fact seems to me to have been entirely neglected in all recent investigations, I now beg to direct special attention to this matter, and to indicate how far reliance is to be placed upon the germ theory of disease, and the use of disinfectants as controlled by that theory. In the first place, then, I shall endeavor to show that the effects which are witnessed in certain diseases are not caused by micro-organisms, but by chemical substances which are elaborated in or by them by way of secretion, excretion

or otherwise; and, secondly, I shall show that the methods now commonly employed by many microscopists and physiologists for testing the action of disinfectants are entirely and radically erroneous.

To demonstrate my views upon the first of these subjects, I will take three well known facts, and consider each very briefly.

In the report of the Medical Officer of the Privy Council for 1876, there is a description of some carefully conducted and important experiments made by Dr. Burden Sanderson, in confirmation of the earlier investigations of Panum. In these experiments a septic solution was prepared by precipitating putrilage with alcohol, re-dissolving the precipitate in water, evaporating the extract to dryness and re-dissolving the dried residue in water. From a series of physiological experiments made with this solution, Panum arrived at the conclusion that 'there exists in putrid fluid a specific chemical body which is soluble in water, and is endowed with the property, when introduced into the circulating blood, of calling into existence that peculiar group of symptoms which are recognized as those of septic infection;' and, to use the words of Mr. Simon in reviewing these results, 'Dr. Sanderson, though apparently still supposing that the septic ferment is particulate, seems to regard, as proven by Prof. Panum's experiments, as well as approximately by his own, that it "does not consist of living organisms."' It has been proved then that micro-organisms, in course of putrefactive fermentation, initiated by them, produce one or more chemical products, which act as specific poisons and as infectants in pyæmia, septicæmia, etc.

The attenuation of the virus of chicken-cholera, which has been described by Pasteur, admits only of a chemical explanation. How can it be explained that micro-organisms,

\* British Medical Journal.

freshly cultivated in clear *bouillon de poule*, exhibit a murderous fatality when inoculated under the skin of previously healthy fowl, while the same micro-organisms, in equal number and activity, taken from a cultivation mixture which has been freely exposed to the air for a long time, are devoid of this property? To suppose that a morphological change can account for the observed difference in effects is, if not actually absurd, at least entirely unwarranted; and the only explanation is that the micro-organisms in question have nothing to do directly with the poisoning effects we are considering, but that they are due to a specific chemical product which is present in the freshly cultivated mixture, but which is absent in the stale mixture. Possibly it is destroyed by oxidation carried on by atmospheric oxygen.

Again, in the thirteenth annual report of the Local Government Board, Dr. Klein has described experiments which seem at first blush to indicate a variability in the degree of virulence of the *Bacillus anthracis*, but further experiments proved that the observed facts were 'irreconcilable with the assumptions (1) that the bacillus is in reality capable of undergoing a diminution of its physiological activity—that is, suffering a real attenuation, and (2) that there exist anthrax bacilli having an intrinsic virulence of various degrees.' He then adds, 'The fact seems, however, capable of another explanation. Owing to different conditions of growth, for example, high temperature, or other artificial conditions, or owing to different soil on which they grow, for example, the body of a mouse or of a guinea-pig, the bacilli, although themselves the same, embody or appropriate, chemically or otherwise, some new or different substance, which produces the alteration for a particular species of animals. Whether this substance is comparable to a ferment or not, I am not in a position to say; possibly

it is some ferment produced by the new conditions.'

It will at once be seen that Dr. Klein almost embraces the chemical theory of disease, which for some years I have persistently advocated; at least, he has himself furnished evidence which gives immense support to my views.

Prof. Virchow also, while hesitating to allege the inadmissibility of a mechanical hypothesis of disease caused by micro-organisms, yet clearly thinks the assumption of chemical action remains as the only real explanation, as will be evident to all who are conversant with his writings, and notably with his article on 'Infectious Diseases in the Army,' which has been translated from the German by Dr. J. James.

The chemical theory places us at once upon ground with which we are familiar, and gives us an assurance of security. Just as the yeast-cell decomposes a solution of sugar by the agency of a soluble zymase which it is supposed to produce, and as the *Mycoderma aceti* oxidizes (by the assistance of the air) alcohol into acetic acid, and as the *Bacterium lactis* sours milk and produces lactic acid, so also do the micro-organisms which initiate putrefaction produce definite chemical products, which act as blood-poisons; and the micro-organisms which are known to be intimately associated with certain specific diseases act as the excitants, not in a primary or mere mechanical sense, but in a secondary sense, viz., by the agency of chemical substances elaborated by them under suitable conditions.

These reflections necessarily take us a step further. If there be no sugar present in its soil, the yeast-plant can not produce alcohol; but it is not to be assumed (at least, in the absence of sufficient evidence) that this micro-organism can live only upon sugar. It is highly probable, indeed, that any one micro-organism can live and thrive under a



variety of conditions and upon a great number of soils; and so the products of fermentative change must necessarily vary accordingly. Many of them may be poisonous in character while many others may be innocuous. So also it must be with the micro-organisms which are associated with disease, in consequence of which it follows that so-called zymogenic organisms may become pathogenic in character—simultaneously with a change of soil or other condition—and *vice versa*.

Reviewing all these possibilities and facts, is the science of disinfection to throw overboard all accumulated knowledge, experience and faith in the action of all disinfectant substances which are not under all conditions germicidal in property? Is the object of mankind henceforth to be the destruction of micro-organisms? If such an object could possibly be regarded as well founded, even then it were idle to attempt its consummation, for micro-organisms are ubiquitous and constitute a necessary order in creation. By acts of hydrolysis, and oxidation carried on upon all dead organic matter by their agency, such substances are resolved into final innocuous products of change, which are essential to the well-being of the higher orders of creation (plants and animals).

The fact is, that men always outstep the natural limits of a discovery and jump at conclusions which are not warranted by the results of further investigation. The somewhat sudden discovery of the intimate association of micro-organisms with disease led many to think that, in order to prevent the spread of disease, the micro-organisms must be killed wherever met with; but, now that scientific investigation has proceeded to a further stage, it is being found that it is not the micro-organisms themselves that are poisonous to man, but the products to which they give rise under certain conditions. Those, therefore, who have the charge of the

public health must now trim their sails anew, and henceforth the study of this matter enters upon a new phase, which is chemical in its character. We must now seek to discover under what conditions and from what substances various micro-organisms elaborate poisonous substances, and also to determine the chemical composition of these products.

In the meantime physiologists and microscopists must abandon their old methods of testing disinfectants. It will no longer serve, in order to ascertain the value of a disinfectant, to take a particular colony of micro-organisms and expose them to the presence of the disinfectant, with the view of ascertaining if they are killed thereby, by means of subsequent attempted isolation and culture; nor will it suffice to expose a colony of micro-organisms to the presence of disinfectants, and, after isolation, to inoculate animals therewith. On the other hand, the infectants must be introduced into the bodies of animals simultaneously with and in the presence of the disinfectant, and if the specific disease do not follow upon the inoculation the disinfectant is a reliable one for that particular set of circumstances.

After all, then, we fall back upon old lines of policy, and must have recourse to chemical substances which act on the one hand as antiseptics, thereby preventing micro-organisms from multiplying and producing poisonous substances (real infectants) and substances which by chemical changes, such as oxidation and chlorination, act in a destructive sense to the same chemical poisons if they happen to be already in existence. Indeed, the idea of employing some active chemical poisons, such as carbolic acid, sulphurous anhydride, absolute alcohol, creosote, chlorine and corrosive sublimate for the treatment of diseases like cholera, typhoid fever and dysentery is, of course, absolutely out of the question; and the only hope is that a non-poisonous

antiseptic, such as 'sanitas' fluid—which may be administered internally—may be found to supply the means that is urgently called for, of combating such fearful diseases.

Of the nature of the chemical poisons referred to in the preceding paragraphs as constituting infectants related to specific diseases, I can only suggest that they are derivatives of albumen produced by a series of chemical changes involving hydrolysis, and in connection with this subject the investigations of O. Nasse and P. Schutzenberger have already paved the way for the comprehension of results which may be expected to speedily attend new researches into the chemistry of diseases. I particularly refer to such investigations as those conducted by Selmi with reference to pathological basis formed in the tissues and to the experiments of the same investigator, Paterno and others concerning the formation of ptomaines and the alkaloids produced in putrefaction. It may be remembered that Selmi, suspecting that in various diseases poisonous substances are formed in the tissues, and that these determine the death of the patient, analyzed the urine of patients affected with progressive paralysis, miliary fever and rheumatic tetanus and found in all cases that poisonous bases were present. One of these bases resembled nicotine in its properties, while another had the odor of conine, and a third substance (among others) was obtained which was white and crystalline and was capable of determining the conversion of starch into glucose.

These facts, and the well ascertained formation of poisonous alkaloids among the products of putrefied albumen, not to speak of what is known regarding the physiological action of alkaloids generally, including abrin (from jequirity-seeds), may all be regarded as preparatory evidence of the production both in and out of the human body of highly poisonous substances, or infectants,

by the agency of micro-organisms. In conclusion, I wish to add that I am now carrying on a series of investigations concerning the chemical history of some micro-organisms, and I am confident, from the results already obtained, that they will lend strong confirmation to the views I have herein expressed concerning the relations of micro-organisms to disease and the qualifications of disinfectants.

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### Staining Tissues in Microscopy.\* V.

BY PROF. HANS GIERKE.

[Continued from p. 156.]

96. Calberla. Ein Beitrag zur mikroskopischen Technik. Morph. Jahrbuch, iii, 1877, p. 625.

Calberla introduced methyl green and indulin into microscopy. A watery solution of the first differentiates the elemental tissues. The nuclei of the cells of the subcutaneous connective tissue, of the vessels and nerve-sheaths, stain red, the corium cells violet and those of the Malpighian network greenish blue. A combination of methyl green and eosin is highly recommended. (See double staining). Indulin is soluble in warm water and dilute alcohol. A dark blue aqueous solution is best, or a concentrated solution diluted with six times its volume of water. Sections remain in this 5 to 20 minutes, and may be cleared up in glycerin or oil of cloves. Indulin stains the cell contents, and especially the intercellular substance, never nuclei.

[\* Note by translator.—The anilin colors are chiefly obtained from coal tar by a series of complex chemical reactions. The manufacture began in 1856, and nearly all are made in Germany. The first samples put on the market were not all permanent, but by improvements in the manufacture of some, and substitution in other cases, they are now as unflading as any other class of dyes. Their coloring power is very great, a few grains would color all the material required by a microscopist, and they can readily be obtained by mail from importers, such as Pickhardt and Kuttroff, 98 Liberty st., and Lutz and Movins, 15 Warren st., New York City, Read Holliday Sons, 45 N. Front st., Philada., H. A. Gould & Co., 17 Pearl st., Boston.]



97. v. Thanhoffer. Ueber die Entzündung nebst einigen Bemerkungen über die Structur der Hornhaut und über die Eosin Reaction. Centrabl. d. med. Wiss. 1877, No. 49, p. 881.

Eosin was used in investigating blood corpuscles and blood vessels. (See No. 87). Treatment by a one per cent. solution of perosmic acid for a few seconds or a minute before staining, intensified the color and made the preparation more permanent. (This modification of Wisowszky's method is very much to be recommended. I have found best a 3 minute dip in a  $\frac{1}{2}$  per cent. osmic acid bath, then wash well and put in the eosin-alum-alcohol of No. 87).

98. Cech C. O. Eosin als Tinctionsmittel. Zeitschr. f. Mikrosk. i, p. 65-73.

Eosine is recommended for staining.

99. Renaut. Applications des propriétés élective de l'éosine soluble dans l'eau à l'étude du tissu conjonctiv. Arch. de Phys., 1877, 2 Sér., iv, p, 211-243.

Sections are treated  $\frac{1}{2}$  to 1 minute by an aqueous solution of eosin to which  $\frac{1}{3}$  part of alcohol is sometimes added, then washed in distilled water and preserved in glycerin containing one per cent. of salt. The latter is required to counteract the solubility of eosin in glycerin. Protoplasm takes the dye readily. In investigating subcutaneous connective tissue, a solution of one part eosin to 500 water may be injected. Elastic fibers color strongly, granulated protoplasm masses show an intensely red nucleus, fixed cells become rose color, and the bundles of fibrillæ and striated tissue remain colorless. Tactile corpuscles are no darker than protoplasm. Cartilage cells show dark nucleolar granules, but the cartilage proper or fundamental tissue does not stain. The nuclei of the endothelium, those found between Ranvier's cords and

those belonging to Remak's fibres, all stain more intensely than their surroundings.

100. Erlicki. Sur les moyens de durcir et de colorer les tissus de centres nerveux. Progrès méd. 1877. Sep., 29. Revue des Sc. méd., XI, 13; Warschauer med. Zeitschrift, xxiii, No. 15 und 18.

Erlicki used green methyl anilin in his examination of the large nerves. He made a  $2\frac{1}{2}$  per cent. aqueous solution and left sections 24 hours therein. The nuclei of the neuroglia became green, while the axis and ganglia cells remained uncolored. (The dye I have used with the above name does not produce such differentiation).

101. Weigert. Bismarckbraun als Färbemittel. Arch. mikr. Anat. xv, 258-260. 1878.

Bismarck brown, an anilin dye, is recommended for microscopic work and preferred to carmine, picrocarmine, and eosin. Weigert names the following properties of a good dye. It must stain with certainty, quickly and not in excess, and should bear long washing without extraction, must be permanent and capable of preservation in mediums not too highly refractive. The Bismarck brown of the Berliner Actiongesellschaft für Anilin farbenfabrication has these qualities in a higher degree than any other stain. A concentrated solution in water, or a weak alcoholic solution is employed. The first is prepared by boiling the dye in distilled water and filtering. Material hardened in alcohol or chromic acid stains equally well. The staining may be done in a few minutes, but no injury occurs if the sections lie in the dye some time. Mounting is done in Canada balsam after washing in absolute alcohol, or if glycerin is used preferably in distilled water. The nuclei stain most deeply, protoplasmic masses and connective tissue light yellow. Amyloids are not clearly differentiated,

but many plasma cells and bacteria-like forms are. Colonies of micrococci are most deeply stained, and the preparations are especially adapted to photography. (I cannot deny the great value of this dye, but cannot consider it so generally useful as carmine. It undoubtedly has advantages for certain purposes).

102. Ehrlich. (a). Über die specifischen Granulationen des Blutes. Verhandlungen d. Berl. Phys. Gesellsch. May 16, 1879.  
 (b). Arch. f. Anat. u. Phys. 1879. Phys. Abth. p. 571-579.  
 (c). Methodologische Beiträge zur Physiologie und Pathologie des verschiedenen Formen der Leukocythen. Zeitschr. klin. Med. Berlin, I Heft 3.

Ehrlich finds in the anilin dyes a means of distinguishing subordinate groups of similar cells. Each dye brings out clearly the granular contents of the cells which are different and characteristic of each type. These 'specific granules' are clearly shown by taking the blood or parenchyma of the organ under examination, making a thin layer of it on the cover-glass and drying it in a warm place. The cover will be stained, and in this manner Ehrlich made five distinct typical forms of grains in the blood corpuscles that he called  $\alpha$ ,  $\beta$ ,  $\gamma$ ,  $\delta$ ,  $\epsilon$ . Other peculiarities enable these cells to be distinguished. The staining of the granules is a chemical process analogous to the formation of a double salt. The anilins may be divided in two groups differing chemically and histologically. 1. Basic anilins made by combining a dye-base and an acid, such as fuchsin, Bismarck brown, safranin and many others. 2. Acid anilins, in which the active dyeing principle is an acid. The granules or 'eosinophilen' (so called because of their affinity for eosin) stain in all acid anilins, of which Ehrlich has tried thirty. The  $\gamma$  granules or fatty cells, on the contrary, take the basic dyes. A neutral stain may be made by mixing an

acid and a basic dye together, it will be insoluble in water, but soluble in excess of acid dye. For example, add to a strong solution of methyl-blue a concentrated solution of acid fuchsin which is the soda salt of rosanilinmonosulfosäure. To five volumes of the last add, with stirring, 1 volume methyl blue, and five of water, allow it to settle and filter. Red blood corpuscles stain deeply in this solution, leucocytes show crowded violet granules, the  $\epsilon$ -granules absorbent of neutral dyes. These are very small and do not correspond either to the well-known albuminous bodies, or to fat. The  $\alpha$ -granules stain in strong glycerin-eosin, in glycerin-indulin, and in concentrated watery solution of orange. Eosin-indulin-glycerin is most appropriate for the  $\beta$ -granules.

103. Curschmann. Ueber das Verhalten des Methylgrün zu amyloid-degenerirten Geweben. Arch. path. Anat. und Phys. lxxix, 556.

Methyl green is recommended as reagent for amyloid substances. It is better than methyl-violet, staining the degenerate tissue violet, the normal green. Sections may be hardened in alcohol or chromic acid, and finally put in a 1 per cent. or, better, a weaker solution of glycerin or levulose. Canada balsam is not admissible. Degenerate kidneys give the best results. The hyaline urinary tubules become ultramarine blue, the amyloid substance violet, the normal green.

The dye that produces these results is made by Meister, Lucius & Browning, Höchst a Main, and is known as green powder M.

104. Test for Amyloid Substance. Journ. R. Micr. Soc., 1880, p. 500.

Safranin is recommended for amyloid substance because it tinges it orange yellow, all the rest red. May be used in water or alcohol, but not after chromic acid. Acetic acid destroys the differentiation be-



cause everything becomes a uniform red.

(Safranin, as a reagent for amyloid, is much inferior to iodine violet, methyl green, or Leonard's ink (80), and cannot be recommended.)

105. Kyber. Weitere untersuchungen über die amyloid Reaction. Arch. path. Anat. u. Phys., lxxxi, 1-6.

Kyber denies the advantages of the anilins as reagents for amyloid substance. He admits they are pretty dyes, but for the demonstration of amyloid far inferior to Virchow's reaction with iodine and sulphuric acid.

106. Loomis. A simple and speedy method of staining animal and vegetable sections. Amer. Monthly Micr., Journ., i, 143.

Anilin red, 1-300 is used, and cleared in potassium acetate 2-1 of water. The preparations bleach out in a short time.

107. Pfitzer. Die Epidermis der Amphibien. Morph. Jahrb., vi, 479.

Safranin is recommended as the very best nucleus dye. Chromic acid preparations are the best, and after them those made with picric acid. The sections are first washed, then put for a few minutes in a solution of safranin 1, absolute alcohol 100, water 200 parts, then into absolute alcohol. The color is permanent in dammar, but bleaches in glycerin and water.

108. Wolff. Zur Bacterienlehre bei accidentellen Wundkrankheiten. Arch. path. Anat. u. Phys., lxxxi, 139.

Warning is given against certain mistakes liable to occur from the production of fine precipitates that may result from the use of anilin dyes on micro-organisms through alkaline reaction of such fluids, as blood. Treatment with a little acid by dissolving the precipitate will prevent errors.

109. Brandt, K. Färbung lebender einzelliger Organismen. Biol. Centralbl., 1881, pp. 202-5.

Bismarck brown with hematoxylin is used to stain amœbas, heliozoa,

flagellates, etc. The stain should be dissolved in the water in which the organism lives, 1 pt. to 3-5000 of fluid. The Bismarck brown stains the oil granules and the cellulose-like gummy substance peculiar to the protozoa, and leaves uncolored the nucleus and protoplasm that stain so vividly in dead matter.

110. Certes. Sur un procédé de coloration des infusoires et des éléments anatomiques pendant la vie. Zool. Anz., 1881, pp. 208-212. Comptes Rendus, xcii, pp. 424-26.

Ditto. Dosage de la solution de Cyanin pour la coloration des infusoires. Zool. Anz., 1881, pp. 287, 288.

Like Brand, Certes wished to stain unicellular organisms. He used cyanin or bleu de quinolein in very dilute solution, 1-100000, 1-500000. For staining infusoria ordinary water, not distilled, was employed, for white blood and lymph corpuscles, serum. The solutions should be kept in the dark. The oil globules only take this stain, while the nuclei, protoplasm, cilia, cuticle and vacuoles remain uncolored.

111. Flemming. Ueber das Hermannsche Kernfärbungsverfahren. Arch. Mikr. Anat., xix, pp. 317-330.

Ditto. Notiz zur Geschichte der anilin färbungen l. c., pp. 742, 743.

On trying Hermann's methods (No. 80), using a variety of anilins, it was found a large number were not suitable, while some gave very satisfactory results. In the first class were eosin, ponceau, and orange, which did not stain the nucleus distinctly. The same deficiency was found in mauvein, fluorescent red, and fuchsin. If applied to chromic acid preparations, even Bismarck brown is not desirable. But the following are very useful and suitable for chromic acid preparations without hardening in alcohol, viz., magdala red, dahlia and especially safranin. Solid green

furnishes beautiful though pale preparations. Osmic acid did not do so well as chromic, the latter preferred. The sections are carefully washed in water, then laid in the dye as safranin 12-24 hours, then in equal parts alcohol and water. Then washed and put into white boxes with absolute alcohol for half a minute till transparent, then into clove oil, cleared up and mounted in dammar, in which they are permanent.

112. Pfitzner. Ueber den feineren Bau der bei der Zelltheilung auftretenden fadenförmigen Differenzirungen des Zellkerns. *Morphol. Jahrbuch*, vii, 289.

Having repeated many of the experiments with safranin described in former numbers of the *Jahrbuch*, Pfitzner condemns them all, and asserts that no commercial safranin stains a nucleus well. He employed a good dye from Friedrich Schäfer in Darmstadt.

(A good safranin as well as most of the anilin dyes may now be bought at various places, as from Dr. Georg Grubler, Leipzig, Dufour Strasse, 17).

113. Ehrlich. Ueber das Methylenblau und seine klinisch-bacterioscopisch Verwerthung. *Zeitsch. f. klin. Med.*, ji, 1881, p. 710.

Only basic dyes are suitable for investigations of bacteria. Those commonly used, like Bismarck brown, fuchsin, methyl and gentiana violet stain too deeply, some form granular precipitates liable to cause errors. Methyl blue appears to be free from these objections. A solution in water is used, and the dried preparation, soaked for a suitable time, 1 to 24 hours, then washed, dried, and mounted in Canada balsam. The blue used is from Hesterburg, Berlin, Louisenstrasse, 39.

114. Griesbach. Ein neues Tinctious-mittel für menschliche und thierische Gewebe. *Zool. Anz.*, 1882, p. 406.

Iodine green proves to be a superior dye, and in many respects surpasses any of the anilins heretofore used in microscopy. It does not appear to have been before applied, and is preferred in a water solution of 1 part to 35, though it does very well in alcohol. Staining is instantaneous, and the mounts may be in balsam. Unfortunately, iodine green is no longer manufactured, because too costly, and methyl green offers an inferior substitute, which may be applied in a similar manner.

115. Flesch. Kleine Mittheilungen zur histologischen Technik. *Zool. Anz.*, 1882, p. 554.

The application of iodine green and methyl green, supposed by Griesbach to be new, is shown to be old in England, where it was recommended for double staining. Combinations of green and red anilins are recommended. (I have myself used iodine green in 1881).

116. Weigert. Ueber eine neue Untersuchungs-methode des Centralnervensystems. *Centralbl. f. d. med. Wiss.*, 1882, pp. 753 and 772.

Acid fuchsin stains the central nerves in a way hitherto unknown. Fuchsin (of the Badische Anilin Soda Fabrik, No. 130) is used in concentrated solution. Also add 1 gramme of caustic potash to 100 c. c. absolute alcohol in a closed flask, allow it to stand 24 hours, filter, and mix 10 c. c. with 100 c. c. alcohol as solvent for the dye. Alcohol saturated with salt is used as a dehydrator.

If nerve sections are merely treated with acid fuchsin, the differentiation is feeble, but if after staining they are put in alkaline alcohol, and the dye soaked out, the structure becomes distinct because the grey matter chiefly retains the color. The following is the exact process:—Sections hardened in chrome salts are laid in the dye for an hour, then in water and washed, then in dilute alkaline alcohol, in which they remain till the gray substance is distinctly seen.



This must be carefully observed not to miss the best moment. Lay again in fresh distilled water several times changed. If successful, the gray matter will be more transparent than the white, and the whole section reddish. If too pale, put again in the dye, if not distinct, soak in the alkaline alcohol. If satisfactory, dehydrate in salt alcohol and mount in balsam. Such preparations are superior to all others in clearness of detail. A part of the gray matter only is thoroughly stained called by Weigert 'erythrophile' or redloving, but as this matter surrounds the finest fibrillæ in thin layers they become very clear.

(This method is undoubtedly of great value in the examination of nerves, especially in following the very fine fibrillæ, but we think it should be used in connection with the sometimes despised carmine staining. The nerve cells are not colored, and the many details are a serious objection. Seven changes of fluid are required before the section finds a rest in its balsam; and it is difficult to treat a series of sections at the same time).

117. Weigert. Ueber Schnelldhärtung der nervösen Centralorgane zum Zwecke der Säurefuchsinfärbung. *Centralbl. f. d. med. Wiss.*, 1882, p. 819.

In order to prepare the material for the dye treat it with Müller's fluid or dry in an oven at 30°-40° C. about 4 days; without heat, 8-13 days is required. Or a fluid of 2½ per cent. potassium bichromate and ½ per cent. cupric sulphate may be used.

118. Mayer S. Beitrag zur histologischen Technik. *Sitzb. d. Wien. Acad.*, lxxxv; Abth., iii, Februar.

Violet 'B' of Bindschedler and Busch is tried for the first time, and washed in ½ per cent. salt solution 1 to 30. Staining requires from a second to 1 minute. The finer vessels are clearly made out, also fatty tissue, the substance and the nucleus of the connective tissue cells. Elastic

fibres appear ultramarine blue on violet ground. Unstriated muscle, and smaller nerves stand out clearly. They must be preserved in potassium acetate, or dried and put in dammar. (It is very difficult to buy a good sample of this dye, and we think it inferior to others).

119. Bizzozero. Ueber einen neuen Formbestandtheil des Blutes und dessen Rolle bei der Thrombose und Blutgerinnung. *Arch. path. Anat. u. Phys.*

Blood disks are stained with methyl violet, 1 part concentrated solution in water to 5000, 75 per cent. solution of salt. Uses also gentian violet 1-3000 per cent.

120. Elouï. Recherches histologiques sur le tissu connectif de la cornée, Paris, 1881.

Eosin is dissolved in pure glycerin, and fixed by adding alum to the glycerin to saturation.

(Alum is an excellent mordant for many anilins).

121. Errera. La nigrosine comme réactif colorant pour les noyaux. *Procès verb. Soc. Belge de micr.*, 1881, p. 134.

Nigrosin soluble in water is recommended as good for nuclei. Permanent in glycerin and resin.

122. Le Vert de Jade. Nouveau réactif colorant. *Journ. de Microgr.*, vi, p. 470.

Recommends iodine green. (See 110, etc.)

123. Strasburger. Ueber den Theilungsvorgang der Zellkerne, und das Verhältniss der Kerntheilung zur Zelltheilung. *Arch. mikr. Anat.*, xxi, p. 476. Zellbildung und Zelltheilung 3, Auf., p. 141.

A little methyl green is dissolved in 1 per cent. acetic acid to arrest and fix the figures of dividing cells. These take a temporary color. A solution in dilute glycerin is used to tinge preparations in alcohol, which are fixed in a 50 per cent. solution nitric acid. Staining takes place

rapidly, and the spindle-shaped fibres stand out clearly, but the preparations are not permanent.

124. Nörner. Beitrag zur Behandlung mikroskopischer Präparate. Arch. mikr. Anat., xxi, 351.

Magdala red anilin is highly praised as quick, intense, and differentiating. May be applied to alcoholic and chrome preparations. Besides animal tissues it is especially recommended for plants, and especially the lower fungi. The preparations appear permanent, but are not yet old enough to rely on.

125. Certes. On the processes of coloring living micro-organisms. Amer. Micr. Journ., vol. iii, p. 224. Sur les procédés de coloration des organismes vivants. Note complémentaire. Bull. Soc. Zool. France, 1881, p. 21, 226.

Another method of staining unicellular beings. A drop of alcoholic solution of cyanin, Bismarck brown, etc., is placed on a glass slip, and spread. The alcohol evaporates, and when nearly dry put on the drop of water containing the infusoria that will be quickly stained. (See 110).

126. Weigert. Zur Technik der Mikroskopischen Bacterienuntersuchung. Arch. Path. Anat. u Phys., lxxxiv, 275.

The best description of the application of anilin dyes in pathological investigations, and especially as relates to micro-organisms, is in Friedländer's book.

127. Koch. Die Aetiologie der Tuberculose. Berl. klinische Wochenschrift, 1882, No. 15.  
Ditto. Mittheilungen des Kaiserl. Gesundheitsamtes.  
128. Friedländer. Mikroskopische Technik, etc., Kassel und Berlin, 1882.

The following process is given by Koch for demonstrating tubercular bacilli:—The section, or dry preparation, is put for 24 hours in a mixture of distilled water 200, concen-

trated alcoholic solution methyl blue 10, 10 per cent. caustic potash, 0.2. From this the dark blue sections are put in a concentrated aqueous solution of vesuvium for 15 minutes. Then wash, dehydrate with alcohol, clear up in oil of cloves. Nuclei and micrococci will be brown, the bacillus of tubercle a deep blue.

[To be continued.]

## EDITORIAL.

**Publisher's Notices.**—All communications, remittances, exchanges, etc., should be addressed to the Editor, P. O. Box 630, Washington, D. C.

Remittances should be made by postal notes, money orders, or by money sent in registered letters. Drafts should be made payable in Washington, New York, Boston, or Philadelphia.

Subscription-price \$1 per year, strictly in advance. All subscriptions begin with the January number.

The regular receipt of the JOURNAL, which is issued on the 15th of each month, will be an acknowledgment of payment.

A pink wrapper indicates that the subscription has expired.

The first volume, 1880, is entirely out of print. The succeeding volumes will be sent by the publisher for the prices given below, which are net.

Vol. II (1881) complete, \$1.50.

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Vol. V (1884), Nos. 2-12, \$1.00.

**SPECIAL NOTICE.**—We have not hitherto deemed it necessary to send special notices to subscribers requesting them to renew their orders, but since it occasionally happens that the matter is neglected merely from forgetfulness, we have adopted the plan of sending the journal in a conspicuously colored, pink wrapper, to indicate the expiration of subscription. Many such will be sent out next month.

It has also happened several times in the past, that some who have taken the journal since its beginning, and who, as we are well aware, will continue to take it for years to come, have been inclined to expostulate with us for stopping their journal when their subscriptions have expired.

In explanation we can only say that we do not give personal attention to the subscription list, and it is only when we have occasion to refer to it to find an address, or for some such purpose, that we are likely to notice the absence of a familiar name. The



rule is that subscriptions must be paid before a name is entered on the list; and as this involves making an entirely new list each year, we cannot, except at the expenditure of much more time than can be well afforded, compare new and old lists to find the delinquents, and then write to remind them of the matter.

The list for 1886 is already begun, and we are prepared to enter subscriptions as rapidly as they may arrive.

NEW MOUNTING MEDIA.—A correspondent has requested information concerning the stannous chloride used by Professor Smith in his highly refractive medium described on page 161. Since others may also be uncertain concerning the tin compound employed, we may state that stannous chloride is not the bichloride of pharmacists, but is commonly known as the protochloride of tin, the 'salts of tin' of dyers. Professor Smith uses the chemically pure compound, which costs about sixty cents a pound, and this may be obtained of F. A. Reichardt & Co., 96 Liberty street, or of Eimer & Amend, 205 Third avenue, New York.

A good quality of gelatin should be used, such as is sold for photographic purposes. Professor Smith has been using what is known as boro-glyceride instead of gelatin, which fastens the cover-glass as securely as balsam, and is easily cleaned off around the cover.

It is advised to use wax rings for protecting the mounts in this medium, as affording the best and quickest means of finishing the mounts. White sheet-wax is recommended, rings being punched from it of the proper size, and attached by careful heating. Colored cements may then be applied as a finish, but they are not required.

We notice an error in the name hydrochloric acid on page 161, line 15 from bottom of second column. It is rather remarkable that the proofs should have passed through the hands

of author, editor, and proof reader, and still such an error remain, but so it is.

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POSTAL CLUB BOXES.—Box Cy came to this circuit October 5th, with two of Cole's preparations, one a cross-section of cucumber stem, the other a longitudinal section of sunflower stem. Both are very instructive, and the description makes them far more so than they would be without it.

Box E was received at the same time as the preceding one. The preparations are:—

1. *Pleurosigma formosum*. Louis H. Noe.

2. Jaws of water-spiders. T. D. Hodges.

3. Cluster of eggs of elm-leaf beetle. Prof. S. Lockwood.

There is an interesting account of the life and habits of the voracious beetle. The cluster of egg-shells is a very pretty object.

4. *Crisia eburnea*. E. A. Apgar. A very neat preparation, but, unfortunately, not a word of explanation accompanies it. The name is not correctly given in the letter accompanying the box. The specimen is one of the polyzoa, quite common, growing on seaweeds, etc.

5. Infant's tongue, section. R. H. Chase.

6. Brand of May-apple, *Puccinia aculeata*. E. A. Rau. The mounting medium was water, the cement, asphalt; the natural consequence is a dry preparation.

Box Cx was received Oct. 13th, with two preparations of Mr. Cole.

1. Section of nerve.

2. Ossification of cartilage.

Box D was received October 23d, with six preparations of interest. Professor Lockwood writes that the original letter-package of this box had been lost, and the managers had replaced it by memoranda obtained with some difficulty. He commends the preparations as 'unusually interesting.'

1. Unknown fly in fossil gum copal. A. T. Veeder.
  2. Transverse section of tea-leaf and stem. F. T. Aschman.
  3. Striated muscular fibres, injected. T. D. Biscoe.
  4. Section of cat's tail, injected. G. W. Worcester.
  5. Conjugation of algæ. E. L. Cheeseman.
  6. Lung of fœtus. Chas. K. Wells.
- Box Cw came to hand October 31st, with two of Cole's preparations. The objects contained in it are:
1. Primary tissue.
  2. Epidermal tissue.

### NOTES.

— We have received a new edition of the catalogue of Mr. Carl Zeiss from Messrs. Emmerich & Son, who have just received a supply of them. The catalogue is issued in far more attractive style than hitherto, and is much larger than previous editions. It affords a complete list of the microscopical apparatus, including the objectives, made by Mr. Zeiss, with numerous illustrations. Glancing over the pages we notice many changes and additions.

Among the additions may be mentioned an apparatus for measuring the growth of plants, devised by Reinke. In addition to the spectral-ocular, so well known, there is now offered a micro-spectral objective, devised by Engelmann for observations on the action of spectral colors upon microscopic objects. The device is fitted beneath the stage of the microscope, and projects a spectrum upon the object in the field of view. The Abbe analysing-ocular, hitherto advertised, and the polarizing apparatus connected with it, is no longer made, owing to the difficulty of obtaining sufficiently good calc spar for the prisms. Two forms of apparatus for photo-micrography are described, with an illustration of a method of quickly uniting the microscope tube and camera with a light-tight joint.

The catalogue is in German. Mr. Zeiss might find it advantageous to arrange with the Messrs. Emmerich for an edition in English.

— Mr. Zeiss still prefers cedar oil (from *Juniperus Virginiana*) for his homogeneous immersion objectives, and he has lately

succeeded in overcoming the most serious objection to its use, its extreme fluidity. He now offers the oil in a thickened condition, and with a refractive power almost identical with that of cover-glass. We notice that Mr. Zeiss has ceased to make, except by special order, the water immersion objective of 0.75 mm. focus, since experience has shown that such a short focus in a water immersion lens offers no advantage that cannot be more effectively obtained by the use of the  $\frac{1}{8}$ -inch homogeneous immersion.

— The September number of the *Kansas City Review*, an excellent magazine for general reading, published at Kansas City, Mo., contains its usual variety of interesting and valuable articles. The Review comes to us in a new dress, and is henceforth to be an illustrated monthly magazine, but the price is only \$2.50 per year.

— The San Francisco Microscopical Society seems to be most active of any during the summer months. We receive reports of its proceedings regularly from the Secretary, Mr. A. H. Breckenfield. At a meeting in July, Dr. J. M. Selfridge read the paper of the evening, entitled 'Bacteria and Their Relation to Health and Disease.' He reviewed the grounds upon which the advocates of the germ theory rest their case. Extensive quotations from the writings of Koch, Pasteur, Cohn, Sternberg and others were cited, and their experimental work alluded to. These eminent authorities, and many others in sympathy with them, claim that it has been demonstrated beyond all reasonable question, that certain diseases, such as anthrax, fowl-cholera, tubercular phthisis, etc., are produced by the parasitic micro-organisms, bacteria. Dr. Selfridge next stated his own view of the case, which is that bacteria are the result but not the cause of the decomposition of organic substances. He fortified his position by quoting extensively from the writings of scientists holding similar views and by pointing out what he considered the fallacies in reasoning of his opponents, and the erroneous deductions drawn by them from their experiments. He argued that in order to prove that one thing is the cause of another, it must be shown that the cause was in active presence before the thing produced was manifest. In the case of bacteria, therefore, he held that it must be shown that they are in the blood of a given case before the disease manifests itself. For, if they be not pres-



ent until after the disease has brought the system under its influence, the inference is that the bacteria in that case, instead of being the cause, are the result of the disease.

The theory that bacteria cause infectious disease is false, because their presence is not necessary to produce the disease ascribed to them. They are only carriers of poisons (ptomaines), which are generated during the decomposition of organic matter.

Bacteria cannot exist in healthy organisms.

The theory that the use of germicides in infective and zymotic diseases is scientific treatment has been exploded, for it has been shown that the patient's life would be jeopardized thereby.

The value of their presence as a means of diagnosis is admitted.

An animated discussion then arose, in which the advocates of the germ theory, led by Dr. Hallard, stoutly maintained the correctness of their views.

Prof. Hanks presented two slides of gold from quartz collected by him at the mines near Dahlonga, Ga. The peculiarity of the gold consisted in its crystalline condition, its purity, and absolute freedom from coating. Slides of this material will be furnished to members interested in the subject.

Mr. Payzant exhibited specimens of *Eudorina elegans* (living), a beautiful little plant belonging to the group *Volvocineæ*. It occurred in such prodigious numbers as to impart a distinct green color to the water in which it was found.

—We are pleased to notice the success with which Mr. Alfred Allen has conducted the *Journal of Microscopy and Natural Science*, originally the *Journal of the Postal Microscopical Society*. It is now a quarterly, with lithographic plates in each issue; the contents are varied and instructive. The volume which ends this year is full of valuable information for the working microscopist. We congratulate Mr. Allen upon his success, and trust his new venture, the proposed *Scientific Enquirer*, will also prove remunerative.

—The August number of Mr. T. Bolton's Portfolio of Drawings and Descriptions of Living Organisms was recently received from the author. The publication is an excellent one for the general microscopist. This number, the price of which is one shilling, is devoted to the animal kingdom, and contains representations of fourteen species of rhizopods, in-

fusoria, etc.—not very finely drawn, to be sure, but useful to one who wishes to determine species. Mr. Bolton's address is Birmingham, England.

—The annual election of the Washington Microscopical Society was held on the evening of October 13th, when the following officers were elected: President, Dr. Robert Reyburn; vice-president, Prof. William H. Seaman; corresponding secretary, Dr. E. M. Schaeffer; recording secretary, Dr. E. A. Balloch; treasurer, Dr. C. T. Caldwell. The society is slowly growing, and the prospects are good for a prosperous year.

—The *Botanical Gazette* is to be enlarged next year, and the subscription price increased. We are pleased to notice such evidence of its prosperity. It will be made to appeal to a larger circle of readers, and will include some more popular articles, of interest to botanists and others. With three editors, in different parts of the country, there should be no dearth of news at any time.

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## CORRESPONDENCE.

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### Styrax for Mounting.

TO THE EDITOR:—In the August number of the Journal of the Royal Microscopical Society, I find (page 744) a condensed extract of my article on mounting in American storax taken from the May issue of the American Monthly Microscopical Journal. To the extract is added a short paragraph, stating that Mr. J. Deby finds that styrax never dries completely.

I wish just here to state that my experience with the styrax of commerce has been similar to his; but that our southern sweet gum (the exudation of *Liquidambar styraciflua*), when treated as indicated by me, gives a chloroform solution which hardens as thoroughly as the balsam solution, and has the advantage over it of rendering fine details more visible. As far as I have heard from persons using genuine American styrax (or storax), it has been satisfactory as a mounting medium, hardening thoroughly and giving clear and in every way excellent mounts.

A. B. AUBERT.

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### Pseudo-Cyclosis

TO THE EDITOR:—I do not know which was greater, my surprise or my delight, on reading Dr. Wallich's paper in the October number of the Journal, on The Pseudo-Cyclosis in *Amœba*. I

certainly was astonished on learning for the first time that I had been precluded in the observations which begat my paper entitled *Pseudo-Cyclosis*, published in the last March number, and my delight was increased on reading Dr. Wallich's extracts from his papers published so long ago, at seeing that, excepting the hyphen used by me, we both had coined the same word as a name for the interesting movement which we both had studied in the *Amœba*. As I was in absolute ignorance of Dr. Wallich's work done in the Old World so many years ago, I am content, as an humble worker in the New World, of re-discovering and re-naming the phenomenon in question. How is it, let me ask, that the learned Doctor's word has not become, ere this, current coin of the realm? Also that good word of his used in this connection to denote the reciprocal convertibility of endosarc and ectosarc in the *Amœba*, namely, *amœba-basis*? S. LOCKWOOD.

OCT. 26th, 1885.

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### NOTICES OF BOOKS.

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*The Opium Habit.* By F. M. Hamlin, M. D., Auburn, N. Y. Reprinted from The Transactions of the Medical Society of the State of New York for 1885. (Pamphlet, pp. 13.)

In these few pages Dr. Hamlin describes his experience with persons addicted to the use of opium, and his method of treatment, which is rapid and effective.

*The Microscope in Botany.* A Guide for the Microscopical Investigation of Vegetable Substances. From the German of Dr. Julius Wilhelm Behrens. Translated and edited by Rev. A. B. Hervey, A. M., assisted by R. H. Ward, M. D., F. R. M. S. Illustrated with thirteen plates and one hundred and fifty-three cuts. Boston: S. E. Cassino & Co. 1885. (Large 8vo, pp. 15 and 466.)

This is an elegant volume, which should be in the library of every student of botany and histology. The first two chapters treat of the microscope and accessories, adapted to the requirements of American and English students by Dr. Ward. The third chapter deals with the methods of preparing microscopic objects, including the cutting of sections, and mounting, in various ways, examining living organisms, and instructions for making drawings from the microscope. The fourth and fifth chapters are probably the most valu-

able, since the information contained in them is not to be readily found elsewhere. The former treats of reagents for microchemical tests, the latter describes the method of conducting such observations. The methods for the complete microscopical investigation of vegetable structures are here given in a manner that makes the work invaluable to the student, who is also relieved of the necessity of searching through the very scattered literature of this subject.

*The Physician's Visiting List* (Lindsay & Blakiston's) for 1886. Thirty-fifth year of its publication. Philadelphia: P. Blakiston, Son & Co., 1012 Walnut street.

This convenient pocket-book is so well known to practicing physicians that no commendation is needed in this place. It is issued in excellent style, and contains valuable tables that the physician should never be without, as well as a most complete system of recording particulars of cases and visits.

*Elephant Pipes* in the Museum of the Academy of Natural Sciences, Davenport, Iowa. By Charles E. Putnam. Davenport, Iowa, 1885. (Pamphlet, 8vo, pp. 40.)

A vindication of the authenticity of the elephant pipes and inscribed tablets in the museum, from the accusations of Mr. Henshaw in the second annual Report of the Bureau of Ethnology.

*Cholera*, its Nature, Symptoms, History, Cause, and Prevention, with an outline Review of the Germ Theory of Disease, one of the Sommerville Course of Lectures (extended) provided for by the Natural History Society of Montreal. By J. B. McConnell, M. D., Professor of Materia Medica and Therapeutics, and Lecturer on Practical Histology, University of Bishop's College Faculty of Medicine, etc. Montreal: Published by Robert Miller, Son & Co. 1885. (Pamphlet, 8vo, pp. 40.)

A study of the literature of the subject, which appears to have been conducted systematically and with care.

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### Exchanges.

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[Exchanges are inserted in this column without charge. They will be strictly limited to mounted objects, and material for mounting.]

Wanted: Cleaned St. Vincent material, for cash.  
E. A. SCHULTZE,  
Tompkinsville, Staten Island, N. Y.



# THE AMERICAN MONTHLY MICROSCOPICAL JOURNAL.

VOL. VI.

WASHINGTON, D. C., DECEMBER, 1885.

No. 12.

## The Red Snow.\*

BY THE EDITOR.

The red snow which attracted much attention from scientific gentlemen when it was brought home from the Arctic regions by Captain Ross in the year 1818, was by no means unknown before that time. De Saussure, as early as 1760, observed it on Mount Breven, in Switzerland, and since then many others have noticed it in the Alps, Pyrenees, and it seems to occur frequently in all parts of the world. Particular interest, however, was manifested in the material brought home by Captain Ross, and several botanists secured specimens for examination. It will be interesting to recall the narrative of Captain Ross, as published in the description of his voyage for the purpose of exploring Baffin's Bay and discovering a north-west passage. On the 17th of August, 1818, when not far from Cape York, in lat.  $75^{\circ} 54' N.$ , long.  $67^{\circ} 15' W.$ , he observed that 'the snow on the face of the cliffs presented an appearance both novel and interesting, being apparently stained or covered by some substance, which gave it a deep crimson color....

'At two P. M. it fell nearly calm, and I sent a boat with Mr. Ross, midshipman, and Mr. Beverley, assistant surgeon, and a party, to bring off some of the snow, and to make what remarks they could on the circumstances attending it....

'They found that the snow was penetrated even down to the rock, in many places to a depth of ten or twelve feet,

by the coloring matter, and that it had the appearance of having been a long time in that state.... The snow was immediately examined by a microscope, magnifying 110 times, and the substance appeared to consist of particles like a very minute, round seed, which were exactly of the same size, and of a deep red color; on some of the particles a small dark speck was also seen. It was the general opinion of the officers who examined it by the microscope that it must be vegetable, and this opinion seemed to gain strength by the nature of the places where it was found; these were the sides of the hills, about six hundred feet high, on the tops of which was seen vegetation of yellowish green and reddish brown colours. The extent of these cliffs was about eight miles.'

A colored engraving accompanying this report represents the Crimson Cliffs, as they were named, the color being bright crimson, extending down almost to the water.

An examination of the red snow was made by Dr. Wollaston, who regarded it of vegetable nature. His report is published in the Appendix to the work mentioned above.

In February, 1819, about six months after its first discovery by Capt. Ross, Francis Bauer, F. L. S., received a quart bottle full of the melted snow, which he examined to determine the nature of the coloring matter. His results are given in full in a letter to W. T. Brande, Esq., Secr. R. S., which is published in the *Quart. Journ. of Literature, Science and the Arts*, vol. vii (1819), p. 222.

\* Read before the Biological Society of Washington, Dec. 12th, 1885.

At that time it was still a question whether the spherical, red particles were of animal or vegetal nature. Mr. Bauer compared them to the 'pollen of some plants, or to the minute fungi of the genus *Uredo*.' Examining them with higher magnification, he 'soon found several individuals still adhering to their pedicels, the same as I have found in most species of *Uredo*, and which distinguishes these minute fungi from the pollen of some plants.'

In the plate accompanying this interesting article the cells are figured with their pedicels, and also the clusters upon the 'jelly-like spawn,' as the author termed it, which is represented as a mass of small, oval, yellowish, growing cells. The name *Uredo nivalis* was therefore given to the plant.

It is quite evident from the figures that the idea that the plant is an *Uredo* greatly influenced these observations. Yet imperfect instruments may have contributed to the mistakes. There are no pedicels, and the 'spawn' is probably the gelatinous material which surrounds the cells.

In *Philosophical Transactions*, 1820, p. 165, is another article by Francis Bauer, Esq., F. L. S., in which he describes some experiments with the specimens of red snow collected by Capt. Ross. Still maintaining that it is a fungus growth, the writer placed samples in small glass bottles, packed the latter full of snow, and observed a considerable increase of the cells in the course of several experiments. He observed that the plant would not grow on the surface of the snow, but flourished when entirely imbedded in it. The results of these experiments, however, do not seem to possess much value, as they throw no light upon the method of growth or structure of the plant. Even the fact of cell division, under the artificial conditions, seems not to be satisfactorily established.

Professor Hooker, in the Appendix to Captain Parry's Voyage for the

Discovery of a Northwest Passage, 1819-20, Supplement, p. 428, regarded the plant as 'not decidedly a *Palmella*,'\* since the granules are not immersed, yet approaches much nearer to it than to *Uredo*, and he suggested that the generic character of Lyngbye's genus *Palmella* might be modified to include it.

The same writer thus alludes to its occurrence in the Arctic regions:—

'That a plant should vegetate in and upon snow, and that it should do so, too, to such an extent as to cover a tract of eight miles in length, and frequently to a depth through the snow of ten or twelve feet, must, indeed, excite our astonishment.'

In Greville's Scottish Flora there is an interesting account of this minute plant, which is there described as *Protococcus nivalis*, the name first given to it by Agardh. Greville states that the red globules appear reticulated on the surface owing to enclosed granules, usually 6-8 in number, which escape by rupture of the mother cell.

I have examined many cells under conditions favorable for observing any reticulation or granules, but have not detected anything of the kind. It is not unlikely, however, that none of my specimens were in the condition of growth to show granules, which perhaps may be seen in other stages.

The description of Greville, however, seems to be based upon observations on a plant found by Capt. Carmichael on the borders of the lakes of Linsmore, in Scotland, growing 'abundantly over the decayed reeds, leaves, etc., at the water's edge.' This indicates a very different habitat from the polar snows or snow-clad summits of mountains, and there may be a question whether the Scottish and the Arctic plants are the same. However, this author, referring to the distribution of the red snow, writes as follows:—'The most probable conjecture seems to be, that the snow is not the natural situa-

\* *Palmella* Lyngbye, massa gelatinosa, subhyalina, granulis solitariis globosis farcta.



tion of *Protococcus nivalis*, but that, being tenacious of life, it preserves its vitality when cast upon so chilling a surface, and under favorable circumstances even propagates its species..... Having become once established in the snow, it is possible that, by the intense cold of winter, the vegetating power may be suspended beneath the frozen surface, when, in other situations, it would have perished; and thus, on the annual dissolution of the superincumbent snow, our *Protococcus*, numerous as the grains of sand on the seashore, may start at once into renewed life, and seem indeed to have descended unseen from the clouds.'

I was led to review the literature of the red snow for the purpose of discovering some basis upon which its systematic position among the algæ could be established, but so little has been written about the life-history of the plant that it is impossible to assign it to any genus. The observations of Bauer seem to me very unsatisfactory. Agardh did not observe its method of propagation, but established the genus *Protococcus* upon the characters observed by him—globules aggregated, without mucous. This generic character does not hold even for this plant, as Greville observed, and this author, deeming the plant generically distinct from others then known, adopted Agardh's name *Protococcus*, but characterized the genus as follows:—'Globules aggregated, naked, containing granules, sessile upon a transparent gelatinous mass.' Greville, as already mentioned, observed and figured granules which escape by rupture of the parent cell. It may be presumed that these small red or yellowish granules are young cells of succeeding generations, but their growth has not been observed. Baron Wrangel, who regarded the plant a lichen, to which he gave the name *Lepraria kermesina*, placed some limestone covered with the plant in water, and observed a number of globules of a

yellowish color of which the larger red ones seemed to be composed. He also observed the large globules swim about, like infusoria, burst, and give exit to smaller ones. Dr. Hooker, with excellent reason, it seems to me, regarded the plant as a *Palmella*.

In the latest literature of algæ the plant is classed as a *Chlamydococcus*, and it is this that first led me to search the literature for some facts to justify such a classification. It seems to be based entirely upon the fact that Agardh's genus *Protococcus* is now merged into *Chlamydococcus*. Until the method of propagation of this plant is more satisfactorily established, it is impossible to fix its systematic position. I consider the assumption that the red snow is identical with the *Protococcus pluvialis* described by Cohn, is not supported by sufficient knowledge.

The bright red color of this plant may or may not be of special significance in classification. It is not improbable that in its actively vegetating condition the plant is green. This is indicated by the observations of early discoverers. Such a change of color is not unusual among certain algæ. It is a characteristic of many unicellular forms, especially *Chlamydococcus* and *Chlamydomonas*. The change from green to red is of great physiological importance in these instances.

A specimen of the red snow collected by Dr. Kane from the crimson cliffs of Beverly is in the National Museum, designated on the museum register No. 10,119. This specimen was recently brought to my notice by Mr. A. H. Clark. It was in a glass-stoppered one-ounce wide-mouth bottle. The material was evidently put in with water, but is now thoroughly dry. The stopper could not be removed without breaking the bottle, hence I have transferred the contents to another bottle, which is before you.

On examination I find abundance of the cells of red snow in this collection, but the brilliant crimson color is

quite lost, only a faint tinge of red remaining. The diameter of these cells ranges from  $10.8\mu$  to  $30\mu$ .

A specimen was received in January of this year from Poverty Gulch, Colorado, sent by Mr. Alexander McDougall. It is numbered in the museum register 74,537.

From the letter which accompanied this specimen I quote as follows:—

'Sediment of a small quantity of snow gathered in Poverty Gulch, Crested Butte Co., Colorado, at an altitude of 12,000 feet, on the 16th of September, 1884. The snow-fall of 1883-4 was very unusual, proving a great barrier to mining operations in this district. In the spring of 1884 the uplands and valleys that were still covered with snow presented quite a novel appearance, the red and white blended together in beautiful harmony. What it was or whence it came was quite a mystery to the miners, and in hopes that you will elucidate the mystery I take the liberty of sending you a small quantity.

'The snow-ball that yielded this sediment was gathered from snow that was about six feet in depth. It changed its color to brown, but by wetting a few grains and rubbing on white paper it is red.'

I made a few observations on this specimen, and attempted to cultivate some of the cells, but without success. The cells were of a bright red color, sometimes apparently quite naked, but frequently enclosed singly, or three or more together, in a colorless, shrivelled envelope. The cells, exclusive of the outer envelope, measured from  $14.3\mu$  to  $29.2\mu$  in diameter. Occasionally small naked cells were observed only  $6.5\mu$  in diameter.

The contents of perfect and fresh cells appears to be quite clear and transparent, with occasionally a well-defined sort of vesicle of a deeper color than the rest.

When the endochrome was pressed out from the cells into the surrounding water, it contracted in spherical, oil-like masses.

The surrounding envelope is quite hard, tough, and resisting.

—o—

## Photo-Micrography.—II.

BY THE EDITOR.

### 2. Apparatus.

We have deemed it advisable to reverse the intended order of the sub-heads of this division of the subject, that we may have opportunity to test a form of apparatus which we desire to describe in this connection should it prove satisfactory. We will therefore defer the description of microscope and camera until next month, taking up now

#### *a. Plates, Chemicals, Developing Apparatus, Dark-room, etc.*

*Plates.*—It is not our province to advocate the use of any particular band of plates, since all the large manufacturers doubtless furnish good plates. The kind best adapted to photo-micrography is a moderately quick plate that works clear. A plate that yields a negative covered with a general fog, such as some of the more rapid ones are apt to show, is not to be recommended. It must not be inferred, however, that extremely rapid plates cannot be found that work perfectly clear. Some makers, in attempting to excel in the sensitiveness of their emulsions, go so far that a very slight forcing in the development causes a noticeable general fog over the plates. The advantage of extreme rapidity obtained at the expense of clearness in the shadows, is, to say the least, questionable. So long as the plate works clear, its rapidity is a secondary consideration. Doubtless a moderately rapid plate will be most generally preferred for work with powers up to a  $\frac{1}{4}$ -inch, and quicker plates for higher powers.

*Developing Apparatus.*—The necessary apparatus, which should be purchased at the beginning, is the same as would be required for field work. We give a list of the articles, with the current prices appended:—



- 1 2-ounce measuring glass, - \$0.25
- 1 Minim measuring glass, - - 0.25
- 3 Developing trays (for 4 × 5 plates), - - - \$0.60—0.90
- 1 Ruby lantern, - - - 0.75—6.00
- 1 Negative rack, - - - 0.50
- 1 Scales and weights (Apothecary's), - - - 1.00
- 1 Camel-hair dusting brush (flat, 2 inches wide), - - 0.50
- 1 Medicine dropper, - - - .05

*Trays.*—The best developing trays, because the most durable, are made of 'ebonite,' or hard rubber. They are somewhat more costly than those made of japanned iron, but they are well worth the difference in price. Those who intend to do considerable photographic work will do well to use trays large enough to hold two plates at one time. It is a great convenience and saves much time in developing, fixing, etc.

Glass or porcelain trays are also used. Japanned iron trays are quite likely to rust after a time, and finally they will leak. They may then still be used by coating them with paraffin, by melting a piece and flowing it over the bottom of the pan, which effectually stops the leak and protects the metal.

*The Ruby Lantern.*—There are numerous forms of lanterns especially designed for the dark room. The

and 32, which is to be highly com-

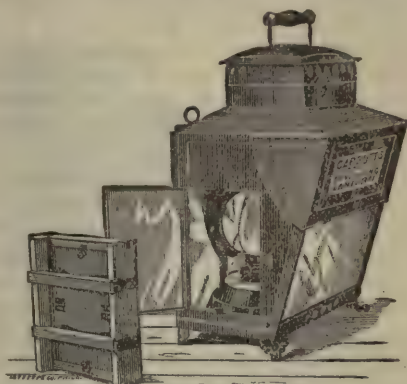


FIG. 32.—Carbutt's Lantern. (Open.)

mended. The price of this lantern is \$6.00, but it can be applied to many important uses. It is about nine inches square by fourteen inches high, and has in front a large ruby glass, giving a safe and abundant light for developing. On the one side is an opal plate, useful for examining plates after fixing, and on the other side a door opens to permit the direct use of the lamp-light. A silvered reflector within can be operated from the outside. There are other good features about this lantern, and altogether it is doubtless the best one made. This lantern is used as the source of light in Scovill's photo-microscopic apparatus.

Next to Carbutt's, and probably quite as good for all practical purposes, is the 'excelsior' lantern devised by Mr. Walmsley, shown in fig. 33. The price of this lantern is only \$3.50. It is a very practical lantern, and deserves to be extensively used.

Another very excellent lantern is Scovill's 'Non-actinic dark-room lantern,' illustrated in fig. 34, which is sold for \$2.00. This lantern is glazed with orange-colored glass; the light is said to be far more pleasant to work with than ruby light, and at the same time quite as safe for the plates. We cannot speak from experience in this matter, but we

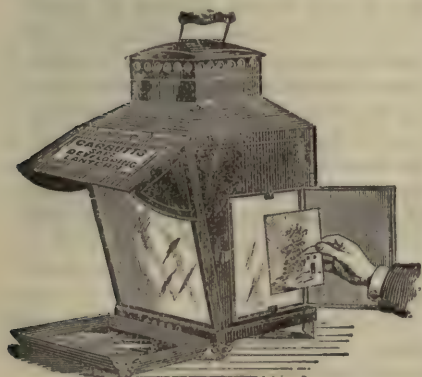


FIG. 31.—Carbutt's Lantern.

most elaborate is Carbutt's 'Multum in parvo lantern,' illustrated in figs. 31

have seen the orange glass in use where it has given perfect satisfac-

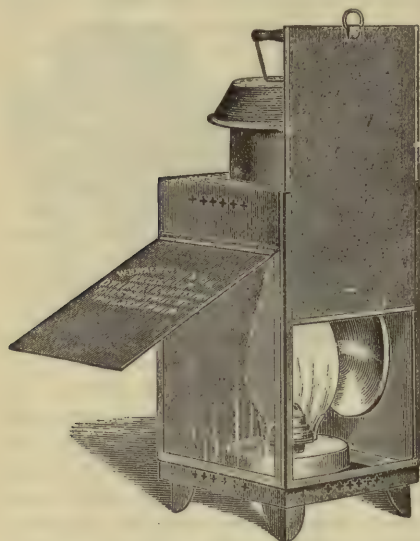


FIG. 33.—Walmsley's 'Excelsior' Lantern.

tion, and have no doubt it is more pleasant, and perhaps less trying, to the sight.

A still cheaper lantern is the 'W. I. A. improved' (fig. 35), introduced by the Scovill Manufacturing Company. The source of light is a candle, and it gives sufficient light for developing, but the reader is strongly advised not to be content with such a small lantern if a larger one can be afforded. Abundance of non-actinic light in the dark room is very desirable, as it obviates the strain upon the eyes, and enables work to be done with far more comfort.

In passing we may mention the very excellent device of Mr. Walmsley known as the pocket lantern, price 90 cents, which is very useful in travelling for changing plates, and even for developing. Another portable lantern is Scovill's 'W. I. A.' lantern, which likewise stows away very well. This, however, is not to be highly recommended, since if the lamp is not very carefully regulated, it produces more smoke for its size than any other apparatus under the sun.

*Negative Rack.*—For drying negatives a rack, constructed of wood as



FIG. 34.—Scovill's 'Non-Actinic' Lantern.

shown in fig. 36, is convenient, but by no means essential. The same object can be satisfactorily attained with small plates, by driving long tacks or nails in an upright board in such a manner that the negative will be supported at the lower corner between two tacks.

*Dark Room.*—This should not be too small for comfort, and it should be fitted up for convenience of working.

Everything should be kept in good order within it, to avoid mistakes in the use of chemicals in the feeble light. Should there be an outside window it may be glazed with orange or ruby glass and an abundance of non-actinic light admitted



FIG. 35.—W. I. A. 'improved' Lantern.



to illuminate the room. Glass of the right color can be obtained from dealers in photographic goods. A less expensive plan is to cover the

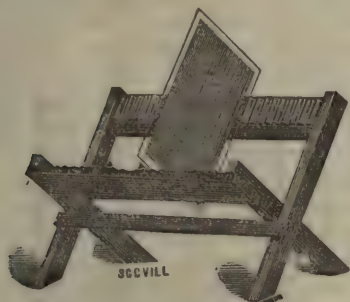


FIG. 36. - Negative Rack.

window with heavy, translucent, orange-colored envelope paper, which admits a tolerably safe light for developing. Mr. E. C. Pickering has made some experiments upon this subject recently, and has concluded that a material known as golden fabric is the best. Some workers prefer to work by the light of the lantern alone, deeming it more uniform, and therefore better, than the light from an outside window. When the window of a dark room opens into another apartment, it is a good plan to place the lamp outside of the window, as the room does not then become heated or contaminated by the products of combustion.

In all cases it is well to test the quality of the light admitted by exposing a plate, partly protected by a strip of opaque paper, to the light, about twelve inches from the window. If after an exposure of fifteen minutes development fails to show any action of light upon the plate it may be considered the light is of good quality to work with.

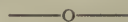
The light should enter the dark room so as to shine directly upon the plate during development. The operator should face the light.

Running water in the dark room is very desirable. If this cannot be had, a tank should be placed on an elevated shelf with a rubber tube

leading the water to the place where it is required. The flow of water may be stopped either by a clamp, by bending the tube upon itself at a sharp angle, or by suspending the open end slightly above the level of the source of supply. This is even more convenient than a stop-cock.

As regards the details of internal arrangements of the dark room, not much can be said, as everything will depend upon the particular circumstances of each case. The water should be close at hand where the developing is done, so the plate may be flooded with water instantly if necessary. There should be a convenient shelf or table for plates and holders, a separate shelf for a tray to contain the fixing bath, and a place for chemicals, developing solutions, and sundry bottles that will constantly accumulate, and be as constantly in demand.

[To be continued.]



### Results of Experiments Upon the Adhesiveness of Some Microscopical Cements.

BY PROF. A. B. AUBERT.

In looking over the literature of microscopy, I have often wondered why no tests have been made of the comparative adhesiveness of the various cements used. Personal experience in the use of cements is undoubtedly of very great value, nevertheless, direct experiment may often be equally useful in deciding what cement to use for a certain purpose. In journals and works on mounting, I found so many more or less conflicting statements, that I decided, as soon as time permitted, to make some tests with our most common cements.

For this purpose I chose metallic cells, having an outer diameter of .77 of an inch and an inner of .51 of an inch; thus offering a surface of adhesion equal to about .2262 of a square inch. To these cells was soldered a loop of strong brass wire; they were then attached with the cements to

heavy glass slides, and put aside to harden for one hundred and three days. The slides with rings were put into a rigid frame, supporting them at both ends, and a hook, with a deep pan attached, was slipped into the loops of brass wire. Sand was cautiously poured into the pan, and when enough had been added to occasion the breaking apart of ring and slide, the quantity added was carefully weighed, and the condition of the cement noted, with the following results :—

Name of cement.	Condition of cement.	Wt. added. Grammes.
R. Miller's caoutchouc cement, - - - -	dry, - - - -	6150
Bell's cement, - - - -	nearly dry, - - - -	4520
Canada balsam, chloroform solution, - - - -	somewhat soft, - - - -	4087
Lovett's cement, - - - -	dry, - - - -	3850
American styrax, chloroform solution, - - - -	a little softer than the Canada balsam, - - - -	3538
King's cement, - - - -	nearly dry, - - - -	3274
Gold size (Winsor & Newton's), - - - -	very soft, dry only around edges, - - - -	2423
Dissolved marine glue, - - - -	nearly dry, - - - -	1867
Zinc white, - - - -	dry, - - - -	1481

By calling Miller's cement 1000 we have the following table representing the comparative adhesiveness of the cements tested :—

Miller's caoutchouc cement, - - - -	1000
Bell's cement, - - - -	735
Canada balsam, - - - -	664
Lovett's cement, - - - -	626
American styrax, - - - -	575
King's cement, - - - -	532
Gold size, - - - -	395
Dissolved marine glue, - - - -	304
Zinc white cement, - - - -	241

Gold size would undoubtedly have stood much higher in the list had it been sufficiently hardened. It certainly showed considerable tenacity when the fact that the edges only were hard is taken into consideration. Most of the other cements were dry enough to make the results sufficiently accurate for comparison.

R. Miller's caoutchouc cement is of English manufacture, and is well recommended. Having only used it for a short time I cannot say much in regard to its qualities from personal observation.

Bell's cement is said to be a solution of shellac in alcohol. It has al-

ways worked well in my hands for glycerin, camphor, water, and some other liquid media.

Canada balsam I have only used as a mounting medium, and should fear that it might become too brittle in time to be reliable as a cement.

Lovett's cement\* consists of thoroughly mixed, finely powdered white lead 2 parts, red lead 2 parts, litharge 3 parts. For use the powder is mixed with gold size to the consistency of cream, and the cells immediately fastened to the slides. They will be found quite secure in two weeks. It is the best cement I know of for liquids containing alcohol.

American styrax is an excellent mounting medium. It would probably remain tough longer than Canada balsam. I have never used it as a cement, however.

King's cement, prepared by J. D. King, Cottage City, Mass., I have found to be a pleasant cement to finish mounts with. The label states that it is 'strong and reliable to attach cells and secure fluid mounts.'

The gold size I use is of Winsor & Newton's make, it dries rapidly and is very tough; my experience with it is such that I consider it one of the safest, if not the safest, of our common cements. Cells made many years ago, which have been roughly handled, show no tendency to crack or loosen.

Dissolved marine glue is a fusel oil (amylic alcohol) solution put up by Robert Howard, of Birmingham, England. The label states that it is 'very good for fixing cells, or making zoophyte troughs, etc.' My experience with it is so limited that I am unable to say anything additional.

The zinc white cement (benzole solution of gums) was prepared by Geo. F. H. Markoe, 61 Warren street, Boston, Mass. I like this cement very well for dry mounts, but have always been in the habit of covering it with a ring of gold size.



I have found asphalt cement and Brunswick black so brittle that I did not test them, but hope to do so hereafter, when I expect to add still other cements to my present list.

Let it be remembered that the foregoing tests must be looked upon as comparative only, not as absolute; they were made to assign places to cements in a comparative list. To determine the absolute adhesive strength of a cement a large number of tests of that one cement would have to be made under various conditions. I have at present too little time at command to undertake so complicated a series of experiments.

ORONO, Maine.

### The New Star Microscope.

Through the courtesy of Mr. Walmsley we are enabled to present an illustration of the 'star' microscope, recently introduced by the Messrs. Beck. It is an attractive, low-priced microscope, with rack adjustment, fine focusing screw at the back of the limb, according to the latest and most approved design, sub-stage ring, and swinging mirror-bar. The base is solid, and the instrument is admirably arranged throughout. Its simplicity and general utility will cause it to be in great demand during the holiday season. Mr. Walmsley declares it is 'the most wonderful cheap instrument ever made.' It is represented in Fig. 37. The demand for low-priced but useful microscopes is increasing, and we are glad to en-

courage it as it tends to make microscopy more popular and increases its usefulness.



FIG. 37.—New Star Microscope.

### Diatoms and How to Collect Them.\*

The diatoms or bacillaria are small and single celled microscopic plants, belonging to the class of kryptogams. Their color is due to a peculiar coloring matter, diatomin. When living, the plants are colored greenish-brown or brown. The walls are composed of silica, and resist decomposition after the plant has died. To this circumstance is due the origin of infusorial earths, and you well know what colossal deposits are found in different localities, and what a large share these little organisms have had in the formation of the surface of the earth. The walls are composed of two parts, which fit one in another, like the cover of a paper box, forming the two principal sides, which show the beautiful markings of the diatoms.

The belts (hoops) of the diatoms are smooth or striped and otherwise marked, and if you boil them with strong acids they will come off; so that the two principal sides will be isolated. If you want to make a preparation you always have to remove the belts, which costs sometimes a great deal of trouble.

Small as these forms are, their difference in size is sometimes enormous. As regards the larger forms you will, in some cases, be able to observe them with the eye as small white spots; the smallest, however, are only visible when in large numbers, heaped together.

The diatoms are distributed in both fresh and salt water. The first are, as a rule, small, single forms; the latter, however, large and diversified.

I will give you some information about collecting them. The marine species are partly attached and partly free forms. You have to take a

spoon and a walking-cane to which to fasten the spoon, some well corked glass bottles, and some pieces of blotting-paper. The locality where to collect will be a brackish swamp, or parts of the sea-shore within the ebb and flood tide. The free-living forms you will find on the algæ that float in the water, and the browner these algæ look the more certainly you may expect to find diatoms upon them. Stones lying in the water and covered with a slimy substance will also yield diatoms. If you take these algæ and press them carefully you can keep them in the blotting-paper.

The mud on the ground will yield a great quantity of diatoms, but where the ground is sandy or stony you need not look for them, except where the ground has a slimy touch.

Take the surface of the mud away one inch thick with the spoon and put it in the bottles. When you get home put the mud on a plate and let it dry. In spring or autumn, when the diatoms are copulating, you will be able to observe them. The mud then will change in color to brown or yellow. In this mud some air-bubbles will be formed by the diatoms, which tear the tender, thin skin, and will float on the surface of the water. You then only need to catch these flakes, or take up the mud with the spoon. This is immensely rich material and is composed only of diatoms.

I have discovered a new system of obtaining specimens from poor material. Take the material and dilute it well with water in a bowl, and let it stand about a quarter of an hour. The mud must be well stirred in the water so that it looks like muddy water. Let it stand and rest again. The heavy mineral particles will sink down. After a quarter of an hour the water will be clear again, but on the top all vegetable particles will float. If you have a small, fine sieve, pour the water through and all the rough parts will remain in the

\* Translated by Mr. Brunno Muller. It should be stated that this article is a translation of a familiar, private letter of Mr. Carl Muller, an experienced collector and preparer in Germany, to his brother, who, at the editor's request, has translated it for the Journal.



sieve, while the diatoms will go through and will float on the surface of the water; let it stand about a quarter of an hour, when the diatoms will have settled on the edge of the plate, and there form a greenish-black border, which you can take off and put under the microscope.

### Provisional Key to Classification of Algæ of Fresh Water.—V.

BY THE EDITOR.

[Continued from p. 174.]

#### III. ORDER CONFERVOIDEÆ Kirchner.

##### c. ULVINÆ. Group 3.

##### *Synopsis of Genera.*

##### 1. Foliaceous; cells in a single layer.

Thallus crustaceous.

*Protoderma*, 69.

Thallus attached, erect, leaf-like.

*Prasiola*, 70.

Thallus membranaceous, crisped, attached or floating.

*Ulva*, 71.

Thallus filiform. *Schizomeris*, 72.

##### 2. Membranaceous, tubular or vesicular.

Thallus vesicular, globular.

*Physodictyon*, 73.

Thallus tubular.

*Enteromorpha*, 74.

Thallus open or saccate; cells rounded, not close.

*Monostroma*, 75.

##### 69. Genus *Protoderma* Kützing.

Thallus crustaceous, indefinitely expanded, closely adherent to the substratum; cells angular, irregularly arranged, closely connected. Propagation unknown.

##### 70. Genus *Prasiola* Agardh.

Thallus leaf-like, erect, spreading from an intricate mass of colorless filaments forming a root-like attachment. Cells angular, more or less arranged in groups of 2-8-16, separated by clear spaces.

Division of cells in two directions.

[Sometimes the thallus arises from a slender petiole-like attachment and expands into a broad, palmate leaf.]

##### 71. Genus *Ulva* Linn.

Thallus membranaceous, expanded, undulately curled or crisped, composed of a single stratum of cells, angular from mutual pressure.

Division in two directions. Propagation by zoospores, 4-8-16 formed in a single cell.

[*Ulva* is a marine genus, not often represented in fresh water. The fronds closely resemble *Prasiola*, and it is doubtful whether *Prasiola* may not be regarded as the fresh-water representative of *Ulva*. See also *Merismopedia*.]

##### 72. Genus *Schizomeris* Kützing.

Thallus filiform, cylindrical, attached, cells in a single plane, dividing first in one direction, later in two directions forming groups of four. Frond constricted here and there.

##### 73. Genus *Physodictyon* Kützing.

Thallus vesicular, globular; cells angular.

##### 74. Genus *Enteromorpha* Link.

Thallus tubular, branched, attached while young, later free; cells in a single layer forming the tube. Propagation by zoospores.

##### 75. Genus *Monostroma* Thuret.

Frond plane or saccate, simple or lobate; cells somewhat rounded (sometimes quaternate).

[The frond may be either flat and open, or in the form of a tube. The cells are not so closely aggregated as in the preceding genera, and they are frequently surrounded by special, hyaline envelopes, enclosing 1-2-4 cells. We are not acquainted with the genus, but take the description and figures of Cooke for authority.]

#### Family VII. PITHOPHORACEÆ Wittrock.

Filaments like *Cladophora*, but with some of the cells distinctly swelled in their upper part. The spores are formed in such cells, the entire endochrome of the cell passing into the upper, turgid portion, which is club-shaped, leaving the lower part colorless.

##### Genus 76. *Pithophora* Wittrock.

Character same as the family.

[Representatives of this interesting genus have been found in various parts of the country; first by Mr. Wolle, near his home and in New Jersey. We have it now growing in an aquarium in Washington, but the source of this specimen is uncertain.

The mode of branching, and the general appearance of the cells are precisely like *Cladophora*. The peculiar method of spore-formation is distinctive.]

### 3. OOSPORÆ.

Oogonia and antheridia.

After fructification the oosphere produces an oospore, while the former becomes surrounded with a thick wall and becomes a resting cell. Spermatozoids are formed in different cells, and are of variable form. They find their way through an opening into the oogonium, and there complete the fructification by fusing with the oosphere.

In most of the members of this division propagation by zoospores is also observed.

### FAMILIES.

Filamentous, confervoid, aquatic or terrestrial; rootless.

#### SPHÆROPLEACEÆ, VIII.

Filamentous, aquatic, basal cell root-like, attached; spores in globular swellings. CEDOGONIACEÆ, IX.

Flat, spreading, cells with bristles.

#### COLEOCHÆTACEÆ, X.

### Family VIII. SPHÆROPLEACEÆ.

Filamentous algæ, living in water or on land, green, unbranched and rootless, of conferva-like appearance.

Propagation sexual, the vegetative cells becoming sexual organs. The oogonia form their protoplasmic contents by balling it together into a single or many oospheres, throwing out a watery fluid. In the cells destined to produce antheridia the plasma-contents divide into reddish-yellow spermatozoids, which leave the antheridium, enter the oogonia through openings in the walls, and fertilize the oospheres by fusing with them.

These become oospores surrounded with a tough membrane, and their green contents become colored red by an oily substance. After a long time they germinate, while they (in *Sphæroplea*) divide into 2-8 parts, which leave the spore as swarm-cells (zoospores), and, coming to rest, give rise to new filaments.

### Synopsis of Genera.

Green spherical cells, separated, in linear series, in hyaline tube.

#### *Cylindrocapsa*, 77.

Filaments of long, cylindrical-cells, with numerous, regularly spaced vacuoles dividing the endochrome into bands.

#### *Sphæroplea*, 78.

77. Genus *Cylindrocapsa* Reinsch.

Young filaments attached, at first consisting of a linear series of cells, later often producing, by dividing walls parallel or inclined to the long axis, irregular or complex bands.

Cells short, cylindrical, spherical, or oblong, with dense, bright green contents, and starch granules, and thick, colorless envelope.

The oogonia are produced in vegetable cells, which become spherical, the entire contents formed into a single, spherical or egg-shaped oosphere. The walls of the oogonium consist of 3-6 broad, colorless layers (of the cell-wall), widely separated at the poles, but close laterally.

The antheridia are produced in the same filament by division of a vegetative cell in 2 or 4 daughter cells, not surrounded by special envelopes, in each of which 2 spindle-shaped spermatozoids of yellow color with a hyaline anterior portion, containing 2 contractile vacuoles and 2 cilia, are formed. Escaping, these make their way to the oogonium, the wall of which has opened on the side; enter, and fertilize the oosphere. The latter then becomes covered with a double contoured membrane and becomes an oospore; the contents change to a reddish-yellow color, and a long resting period fol-



lows. Its further history is not known.

[The oval or spherical cells, which may or may not be surrounded by thick, lamellose, hyaline envelopes, are arranged in a linear series within a tubular, hyaline, gelatinous cylinder (or vesicle, as Reinsch designates it). The cells are full to repletion with green, granular contents. Immediately after division the cells are in contact, and therefore truncate in form. Propagation by swarm spores has not been observed. Compare *Hormospora*, 16.]

The cylindrical sheath is closed at both ends, the upper end rounded, sometimes expanded, with several green cells in the club-shaped interior; the lower end is narrowed and attached.]

#### 78. Genus *Sphæroplea* Agardh.

Filaments composed of long, cylindrical cells, which, in the vegetative condition, have green, protoplasmic contents, which is divided by large, regularly placed vacuoles, into a number of equidistant rings or bands. The vacuoles are enclosed in a membrane, and the single cells appear, therefore, to be divided by false septa.

All vegetative cells are transformed into sexual organs. Oospheres numerous in a mother cell, of a dark green color. The oospores, after fertilization, produce three membranes, the outer of which is thrown off, leaving a colorless, widely separated, longitudinally or irregularly wrinkled or plaited epispore, a colorless close-lying endospore, and red contents.

The spermatozoids are formed in innumerable number by the division of other vegetative cells into yellow portions; they are yellow, elongated, with a thick hinder end, a beak-like, colorless anterior portion, with two cilia, and escape through openings formed in great number in the wall of the antheridium, and find their way to the oospheres.

The zoospores coming from the oospores are spherical, cylindrical or

pear-shaped form, carmine-red or red and green, with hyaline end and two cilia.

[The contents of the cells sometimes appears quite frothy from the numerous vacuoles, especially just previous to fructification.]

—o—

### Fixing arranged Diatoms and Sections.

Among the many methods of fixing diatoms and other minute objects upon a slide or cover-glass, the method of M. Threlfall has been very highly commended. The diatoms are arranged upon a perfectly dry surface of caoutchouc spread upon the slide, and fixed in place by application of gentle heat. The details may be briefly given as follows:—First prepare a solution of caoutchouc in benzene, adding sufficient caoutchouc to produce a jelly-like mass. Of this take a portion as large as two peas, and dissolve it in thirty cubic centimetres of benzene. This dilute solution is the one that is used. Crude caoutchouc should be used, or such as has not been vulcanized.

This solution affords an easy means of attaching thin sections in series as well as diatoms to a glass slip. In either case the slip is coated with a thin layer of caoutchouc by flowing it with the solution as a photographic plate is coated with collodion. The solvent rapidly evaporates, leaving the caoutchouc in a thin film on the glass. The sections, ordinarily included in paraffin, are arranged in series on the caoutchouc. The slide is then warmed to a temperature of 56–60° C., when the caoutchouc softens, and the sections become fixed in place. The paraffin is then removed by petroleum spirit, and if it is desired the sections may be stained in position.

To attach diatoms it is only necessary to arrange them on the layer of caoutchouc and warm gently.

This method of fixing diatoms is highly commended by P. Francotte.\*

\* *Bull. Soc. Belge de Micr.*

### The Striæ of Diatoms on the Möller Probe-Platte.

The following table is presented for convenience of reference. It was prepared a number of years ago—the date we do not remember, but it is of no great consequence, as we are not aware of any corrections of the numbers given in the last column.

— EUPODISCUS ARGUS, - - - - -	C. G. Ehrenberg.		
1 TRICERATIUM FAVUS, - - - - -	C. G. Ehrenberg,	Hexagonal,	3.7
2 PINNULARIA NOBILIS, - - - - -	C. G. Ehrenberg,	Transverse,	13.0
3 NAVICULA LYRA Var., - - - - -	C. G. Ehrenberg,	Transverse,	16.0
4 NAVICULA LYRA, - - - - -	C. G. Ehrenberg,	Transverse,	24.5
5 PINNULARIA INTERRUPTA, - - - - -	W. Smith, - - -	Transverse,	26.0
6 STAURONEIS PHŒNICENTERON, - - - - -	C. G. Ehrenberg,	Transverse,	34.5
7 GRAMMATOPHORA MARINA, - - - - -	W. Smith, - - -	Transverse,	38.4
8 PLEUROSIGMA BALTICUM, - - - - -	W. Smith, - - -	Transverse,	33.1
9 PLEUROSIGMA ACUMINATUM, - - - - -	{ F. T. Kützing, } A. Grunow, - - -	Transverse,	46.4
10 NITZSCHIA AMPHIOXYX, - - - - -	W. Smith, - - -	Transverse,	49.2
11 PLEUROSIGMA ANGULATUM, - - - - -	W. Smith, - - -	Diagonal,	47.0
12 GRAMMATOPHORA OCEANICA ( <i>G. subtilissima</i> , J. W. Bailey), - - - - -	C. G. Ehrenberg,	Transverse,	61.6
13 SURIRELLA GEMMA, - - - - -	C. G. Ehrenberg,	Transverse,	53.5
14 NITZSCHIA SIGMOIDEA, - - - - -	W. Smith, - - -	Transverse,	62.0
15 PLEUROSIGMA FASCIOLA, - - - - -	W. Smith, - - -	Transverse,	58.0
16 SURIRELLA GEMMA, - - - - -	C. G. Ehrenberg,	Longitudinal,	67.0
17 CYMATOPLEURA ELLIPTICA, - - - - -	A. DeBrébisson,	Transverse,	63.0
18 NAVICULA CRASSINERVIS ( <i>Frustulia Saxonica</i> , L. Rabenhorst), - - - - -	A. DeBrébisson,	Transverse,	86.2
19 NITZSCHIA SIGMA Var., - - - - -	W. Smith, - - -	Transverse,	90.0
20 AMPHIPLEURA PELLUCIDA, - - - - -	F. T. Kützing,	Transverse,	95.2
— EUPODISCUS ARGUS, - - - - -	C. G. Ehrenberg.		

### Staining Tissues in Microscopy.—VI.

BY PROF. HANS GIERKE.

[Continued from p. 216.]

129. Ehrlich. Börner's d'tsch. med.

Wochenschr., 1882, No. 19.

The modification of Koch's method, introduced by Ehrlich and now everywhere adopted, consists in substituting for potash, anilin, which is a yellowish, oily fluid, that, diluted with water, dissolves the dye much better than the dilute alkali. Strong mineral acids are used for bleaching. He thinks the bacillus of tubercle is inclosed in a sac, which is only penetrated by alkalies, not by acids or neutral solutions. If the dye is alkaline it will be bleached by acids. These dissolve the dye and remove it from the other constituents of the preparation, but cannot enter the inner part of the tubercular bacillus,

The first column gives the number of the diatom on the test-plate, the second the name of the diatom, the third the person who named it, the fourth the direction of the striæ, and the fifth the number of lines in the thousandth of an inch, as determined by Professor E. W. Morley, whose experience gives authority to the results.

hence it remains colored. The recipe is as follows:—Sprinkle a little anilin in water to make a 3 per cent. solution, filter. Add a strong alcoholic, basic anilin color, as gentian violet or fuchsin, till a precipitate forms. Filter, and the stain is ready. Let the material soak for 24 hours in the cold, or one hour in a warm chamber at 50°. The sections are then transferred to 30 per cent. hydrochloric acid till they appear bleached, which only takes 1–3 minutes; they are then dehydrated in absolute alcohol and cleared in oil of cloves. The tissues may be subsequently stained with other colors.

130. Baumgarten. Ueber ein bequemes Verfahren, Tuberkelbacillen in Sputen nachzuweisen. Centralbl. f. d. med. Wiss., 1882, No. 25.

A modification of the two preced-



ing processes. Sputa is dried in the usual way, and moistened with a very little dilute potash lye (1-2 drops of the 33 per cent. solution to a watch-glass of water). The bacillus may now be easily seen with a power of 400-500. To avoid changes, dry the cover-glass again, pass two or three times through a gas flame, then treat with a drop of rather dilute anilin violet, or other anilin adapted to stain nuclei. The bacteria of putrefaction will become intensely blue, but the bacillus of tubercle will remain colorless.

The numerous processes of 1883 cannot yet be brought together and presented here.

From the text-books on Microscopy may be added:—

131. Beale. How to work with the Microscope, 5th ed., 1880, p. 127.

Solferino and magenta are old names for our fuchsin, and they appear to have been much used in England. The dyes are boiled in water, to which a little alcohol is added, 10-15 drops to the ounce. Magenta was recommended by Dr. Roberts in 1863, in Proc. R. Soc., xiv, p. 481, on peculiar appearances exhibited by blood corpuscles under the influence of solutions of magenta and tannin.

132. Frey. Das Mikroskop und die mikroskopische Technik, 7. Aufl., Leipzig, 1881, p. 101.

Anilin blue that is insoluble in water but soluble in alcohol, may be made soluble in water by treatment with sulphuric acid, and may then be used in water, or as follows:—Soluble blue 2 cg., water 25 cc., alcohol 20-25 drops. This fluid is especially to be recommended for those materials that are hardened in alcohol.

#### DIFFERENTIATION OF TISSUE ELEMENTS BY THE REDUCTION OF SILVER SALTS, ESPECIALLY SILVER NITRATE.

Out of the great number of articles

relating to this method, we select only those methods that have a particular technical or historical interest.

133. Flinzer. De argenti nitrici usu et effectu præsertim in oculorum morbis sanandis. Diss., 1854, bei Coccius gearbeitet.

The observation is here recorded that after treatment with lunar caustic a precipitate is formed between the cells of the cornea.

(After v. Recklinghausen See No. 138.)

134. His. Beiträge zur normalen und pathologischen Histologie der Cornea. Basel, 1856.

On treatment of the cornea with lunar caustic a granular precipitate forms in the canals, or in the fundamental tissue. He calls the first intercellular, the latter extracellular. He applies the pencil to the cornea.

135. V. Recklinghausen. Eine Methode mikroskopische hohle und solide Gebilde von einander zu scheiden. Archiv pathol. Anat. xix, 451.

Fresh or dried animal tissues are put into a weak solution of silver nitrate, then in a dilute brine in order to arrest the further action of light. A fine, thick, black silver precipitate is thus formed in all parts containing much water, while portions more solid escape the feeble action of the silver salt and remain colorless, or with longer treatment show scattered grains, or diffuse staining.

(The best method of staining with silver is to lay the material in a  $\frac{1}{4}$  to  $\frac{1}{2}$ % solution of a silver salt for 20 to 40 seconds, moving it about in the solution, taking care that sections do not cling together. Then drop at once in a .75% salt solution, moving them actively as before, then exposing to the light.)

136. V. Recklinghausen. Die Lymphgefäße und ihre Beziehung zum Bierdegebe. Berlin, 1862, p. 5.

The results of continued experi-

ments with silver nitrate are here described. The exterior lines of the epithelium are stained black. In connective tissue the silver salt seeks the finer vessels, which are the beginnings of the lymphatic system, and is deposited there as a fine black grainy precipitate. The fundamental tissue of the cornea stains yellow or dark brown. Low powers are recommended, 400 to 500.

137. His. Ueber die Einwirkung des salpetersauren silber oxyds auf die Hornhaut. Schweitzer Zeitschrift f. Heilk. ii. Heft 1, p. 1 (1862).

Weak solutions of silver nitrate, according to His, in former essays, develop the inner cell-substance, strong solutions the outer. His now thinks that the time of treatment is important.

The salt is first deposited in the intercellular substance of the cornea but is soon dissolved out by the surrounding fluids and may enter the cells to be again precipitated under the influence of light or by contact with peculiar compounds in the cells. The method is essentially causticising by silver nitrate.

138. V. Recklinghausen. Zur Geschichte der Versilberungsmethode. Arch. pathol. Anat. xxvii, 419 (1863).
139. His. Ueber das Epithel der Lymphgefäßwurzeln und über die v. Recklinghausenschen Saftkanälchen. Zeitschr. Wiss. Zool. xiii, 455.

Each of these authors claims priority in the use of silver nitrate. Von Recklinghausen insists he discovered the method as a 'new mode of anatomical investigation,' but His (see 134) in 1856 showed that silver in the cornea differentiated intra and extra cellular substance, and Flinzer and Coccus (No. 133) made a similar statement in 1854, but did not carry the application any further.

[To be continued.]

## EDITORIAL.

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Remittances should be made by postal notes, money orders, or by money sent in registered letters. Drafts should be made payable in Washington, New York, Boston, or Philadelphia.

The regular receipt of the JOURNAL, which is issued on the 15th of each month, will be an acknowledgment of payment.

The first volume, 1880, is entirely out of print. The succeeding volumes will be sent by the publisher for the prices given below, which are net.

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Vol. VI (1885), \$1.00.

— To our many subscribers and readers whose faces are not known to us, as well as to the many others whom we number among our friends, we extend a hearty Christmas greeting and wishes for a happy New Year. In a few days the whole civilized world will celebrate a day that has been observed for ages, and comes down to our own time as a day of good cheer to rich and poor. But few are so entirely wrapped up in their own affairs that Christmas tide does not bring out the generous impulses of their nature. On Christmas eve and Christmas morning there is probably more genuine happiness in the world than any other day of the year. Christmas is therefore a great blessing to the world, and we trust all our readers will enjoy it fully.

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WILLIAM B. CARPENTER.—The death of Dr. W. B. Carpenter, the eminent English physiologist and microscopist, was announced last month. Dr. Carpenter has been so closely associated, and intimately acquainted, with the progress of microscopy in England during his long career as a leader in scientific thought, and so well known among microscopists, that we have deferred an extended notice of his life until January, when we shall present our



readers with a portrait which is now being engraved for us from a photograph by Bogardus, taken while Dr. Carpenter was in this country not long ago.

The portrait is, we believe, better than any yet published, and will form an appropriate frontispiece to the next volume, which our readers will no doubt highly prize.

—o—

THE JOURNAL FOR 1886.—The past year has been, unquestionably, the most entirely successful year the journal has yet enjoyed. Owing to a variety of causes, among which we may mention the increased demand for illustrations, the profits of the business have been somewhat less than in some past years; but when we say this has been the most successful year of all, we consider only the journal as a medium of information. We need not pass in review the many articles of value it has been our pleasure to publish this year. Those who have read the journal already know of them, and those who have not read it will probably not read this paragraph.

However, at this time it is proper we should say a few words about the next volume. It is our intention to improve the journal in several respects. We have been very much annoyed this year by irregularities in the paper upon which it has been printed. This we propose to obviate in future, and next year a better paper will be used, upon which illustrations can be printed to better advantage.

With the January number will be issued a fine portrait of the late Dr. W. B. Carpenter, to be the frontispiece of the volume. The portrait will be engraved especially for this journal, and will only be furnished to those who subscribe for the year. Single copies will not be sold.

Among the subjects that will be treated at length next year, photomicrography will have a prominent place. The articles on the genera of

algæ of fresh water, by the Editor, will be continued and brought to an end; as will also the translation, by Professor Seaman, of the valuable historical account of staining processes. The value of both these contributions will be best recognized when they are completed and indexed. A considerable number of interesting articles on different subjects is already in hand awaiting publication, and others are promised.

The very satisfactory condition of the journal, especially as regards the character and value of the articles contributed during the past year, encourages us to devote more time to it in the future than hitherto, for it has now become a publication of recognized value in the field it covers. We shall persevere in the course that has been followed thus far with such satisfactory results, preferring to merit the appreciation of the large and increasing body of earnest students and workers, rather than attain notoriety, and a trifling transient increase of circulation, by a less conservative course.

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MICROSCOPICAL SOCIETIES.—Some time ago we stated our intention to publish each year a list of the microscopical societies in the country, and requested the officers or members to favor us with the names of officers, number of members, and such other information concerning the societies with which they are connected, for this purpose. After waiting several months, we find the number of responses surprisingly small. Although we cannot present the list as representing all the societies in existence, it may fairly be assumed to include, with a few notable exceptions—such as the New York, and the Wellesley College for example, from which we have not received information concerning present membership, etc.—all the societies that are active and prosperous. Omissions can be made up next year. The list includes only those societies whose officers have re-

sponded to our request for information, hence, so far as it goes, it is reliable. The information, however, is quite incomplete in many cases. We hope next year to publish a more perfect list, that will prove of greater interest. It was intended to publish the names of the officers in this connection, but some of the reports came in so late that the officers were named for 1886, while others gave the officers for 1885. We shall be pleased to publish the names of officers of all societies for the year 1886, if the necessary information is received before the first of March.

Bethlehem Microscopical Society, Bethlehem, Pa.

Organized January 10, 1884. Meetings the first Thursday of each month. Membership 16.

Microscopical Society of Camden, Camden, N. J.

Organized Nov. 7th, 1878. Meetings at Microscopical Hall, 46 N. 3d street, on the first and third Thursdays of each month, (usually excepting July and August). Membership 51, average attendance 10. Twenty microscopes are owned by members. Lectures are frequently given. This year Prof. C. H. Kain, Dr. A. P. Brown, Dr. G. T. Robinson, and Prof. E. F. Moody have lectured before the Society. The Society is in good financial condition.

California Microscopical Society, San Francisco, Cal.

Incorporated August 20, 1883. Meetings monthly. A society of ladies who manifest considerable interest in microscopical work.

Cleveland Microscopical Society, Cleveland, Ohio.

Organized May 23, 1882. Meetings on the first and third Mondays of each month. Membership 55. Average attendance 11. The society subscribes for some periodicals, and has the use of the library and museum of the Kirtland Society of Natural Science.

State Microscopical Society of Illinois, Chicago, Ill.

Incorporated March 31, 1869. Meetings on the second Friday of each month from October to May, inclusive. Active members 82, corresponding members 22, honorary members 5. This is one of the oldest established societies in the country; nearly as old, as a corporation, as the Royal Microscopical Society of London, whose royal charter was obtained in 1866.

Iron City Microscopical Society, Pittsburg, Pa.

Meetings once a month. Membership 43. The objects of the society are declared to be 'to bring together all of kindred tastes... and to disseminate a knowledge of and encourage the use of the microscope as a means of research, and of private and social recreation.' The programme of the meetings indicates that the presentation of papers is not regarded essential to the interest of the meetings, but each member is expected to bring at least one object, and the first part of the programme is exhibition of objects. Then follows the 'occasional reading of papers,' then exhibition of books, drawings, photo-micrographs, etc., and finally practical illustrations of microscopical work. The business session begins at 9.30. Saturday afternoon excursions are made for collecting.

Lehigh Valley Microscopical Society, Easton, Pa.

Organized May 19, 1881. Membership 13, and 1 honorary member. The society is in a prosperous condition.

Minneapolis Microscopical Society, Minneapolis, Minn.

Meetings on the first and third Mondays of each month, well attended, and much interest is manifested by members.

Central New York Microscopical Club, Syracuse, N. Y.

Organized April 6, 1880, incorporated May 18, 1883. Meetings on the last Monday of each month, except during July and August.

Richmond Microscopical Society, Richmond, Va.



Organized and chartered 1880. Membership 18. Owns a good library, and subscribes to many scientific journals. Members have the use of a laboratory for research.

San Francisco Microscopical Society, San Francisco, Cal.

Membership 28 and 2 honorary members.

St. Louis Microscopical Society, St. Louis, Mo.

Organized May 24, 1869, incorporated August 17, 1872. Meetings on the first Thursday of each month. Active members 23, honorary members 2.

Washington Microscopical Society, Washington, D. C.

Organized 1884. Meetings on the second and fourth Tuesdays of each month. Membership 27.

In addition to the strictly Microscopical Societies there are several associations having microscopical sections, or which give occasionally microscopical exhibitions. We have before us programmes of the microscopical soiree of the Purdue Scientific Society, Lafayette, Ind., given in June, 1885, and also of the Portland Society of Natural History, Portland, Me., given in April.

## NOTES.

— We are indebted to the Palmer Slide Company, whose advertisement is to be found on another page, for a number of samples of their bevel-edge slides, but recently introduced. These slips are certainly very attractive in appearance, and are well adapted for ornamental preparations. Some are plain glass, very colorless and free from defects, others are flashed with a color on the under surface, which modifies the light, or adapts them very well for opaque mounting. The only criticism we would make of these slides is, that we anticipate careless handling will result in chipped corners. The company also manufactures plain slides of the ordinary kind, but of a superior quality of glass, at very reasonable prices.

— Mr. Woolman has been sending out a circular and a preparation mounted on

the new bevel-edge slide to illustrate the beauty of the mounts on such slips. Mr. Woolman, in further recommendation of the slips, says: 'Aside from the great beauty of the finished object, making them the most elegant slide yet introduced, their bevel-edge allows them to glide smoothly under spring clips on the stage of the microscope. They are made of Chance's crystal plate and Chance's flat crown, and with ground edges, or ground and polished edges.' They vary in price from \$4.00 to \$6.00 per gross.

— Dr. Otto A. Wall has recently assumed charge of the microscopical columns of the *National Druggist*, of which he is associate editor, and has begun a series of articles on the microscopical examination of drugs, which promise to be very useful to pharmacists. The editor of the *Druggist*, H. M. Whelpley, Ph. G., is also instructor in the microscopical laboratory of the St. Louis College of Pharmacy. The laboratory is well equipped with microscopes and apparatus, as we learn from the Prospectus of the college, and claims to offer the best facilities for instruction in the West.

— Thirty-two parts of 'Our Living World,' an artistic edition of the Rev. J. G. Wood's *Natural History of Animate Creation*, already noticed in these columns, have been issued, leaving only ten more parts to complete the work. There is no illustrated popular natural history that equals this, in the interest of the text or the excellence of the illustrations, all of which are accurate. The wood-cuts are well executed and numerous, mostly taken from living animals, but the colored plates are especially fine; for example, the group of young leopards and mother—but they are all worthy of praise, and some of the birds are particularly good. For a popular natural history, this is far better than any systematic work on the subject. The classification of animals has not been disregarded, but this has been made subordinate to the descriptions of the animals themselves, their appearance, habits, and distribution. The publisher is Selmar Hess, New York city.

— A form of cobweb micrometer has been introduced by Mr. Bulloch, which is certainly one of the best we have seen. The workmanship of it is first-class, leaving nothing to be desired in that respect. In addition to the movement of one set of lines with the micrometer screw, another screw, worked with a milled head on the other side of the instrument, moves

both sets of lines together, so that it is possible to set the graduated screw-head at zero for any particular measurement. This is a very convenient as well as useful feature.

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## CORRESPONDENCE.

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### About Magnification

TO THE EDITOR:—Being somewhat interested in the article on page 203, 'The Magnifying Power of an Inch Objective,' I wish to propound the following questions:—

First. What is the magnifying power of an inch lens at 10 inches between object and lens?

Second. What is the formula of a two-inch eye-piece as used in the microscope; not in the telescope?

Third. What is the magnifying power of a two-inch eye-piece, 10 inches between object and diaphragm?

Fourth. Are there fifty microscopes in this country that are furnished with two-inch eye-pieces?

Fifth. What is the length of a ten-inch tube?

Any person who has used the microscope for only a few days will doubtless think himself able to answer any one of the above questions. I want the actual measurements.

WALTER H. BULLOCH.

[Our columns are open for replies to any of these questions. Evidently Mr. Bulloch has been studying this subject of magnification, and now desires to draw out some ideas from others. The questions are worthy of careful consideration. —ED.]

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## NOTICES OF BOOKS.

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*Methods of Research in Microscopical Anatomy and Embryology.* By Charles Otis Whitman, M. A., Ph. D. Illustrated. Boston: S. E. Cassino & Company. 1885. (8vo, pp. viii and 255.)

Dr. Whitman's admirable manual is undoubtedly the most practical treatise on the subjects with which it deals at present accessible to the student who wishes to know how to prepare his materials properly for staining, and how to imbed, section, and mount delicate objects and tissues in accordance with the most recent and approved methods. These methods which have been developed by the work-

ers in the laboratories of continental Europe, and have been still further improved upon by the untiring efforts of the corps of investigators gathered together at Naples, under the direction of Dohrn, are fully explained in this book. While the work deals very largely with the methods pursued by the embryologist, the working histologist and anatomist cannot fail to be instructed by reference to its pages. It is, in fact, a laboratory manual, explaining clearly the steps by which definite results are to be reached. It is not a mere collection of formulæ, but a treatise by the aid of which the student may instruct himself in that comparatively new art, microtomy, which is revealing so much that is of importance in modern biology. It discusses general and special methods, the enlarged stereogrammatic reconstruction of minute objects from serial sections, the times and places of ovulation of a considerable variety of forms, fixatives, and gives full directions for successfully cutting serial sections. Formulæ for the preparation of reagents are given, and two very useful micrometric tables complete the book. There is a good index. Nothing is said of microscopes and accessories, and their construction or theory. The methods useful to the actual investigator are alone dealt with, leaving the work unencumbered with details which have already been capably handled by Carpenter in his hand-book. J. A. R.

*Recherches Anatomiques sur les Organes Végétatifs de l'Urtica Dioica. L.* Par A. Gravis, Docteur en Sciences Naturelles, assistant du cours de botanique à l'Université de Liege, Secrétaire de la Société Belge de Microscopie. Bruxelles; Librairie Médicale et Scientifique de A. Manceaux, 1885. (4°, pp. 232, plates 23, with explanations.)

An adequate review of this valuable work would require more space than can be here given to the subject. In the introduction the author concisely states his object in preparing the memoir, which was to present an anatomical study of the vegetative organs of a plant throughout its whole extent and in all stages of growth. The result is a knowledge of the variations of structure which these organs undergo.

The structure of the plant has been thoroughly studied and described in detail, with the aid of beautifully drawn figures. We have not even space in which to give a summary of the results, but must refer botanists to the original work, which will reward careful study.



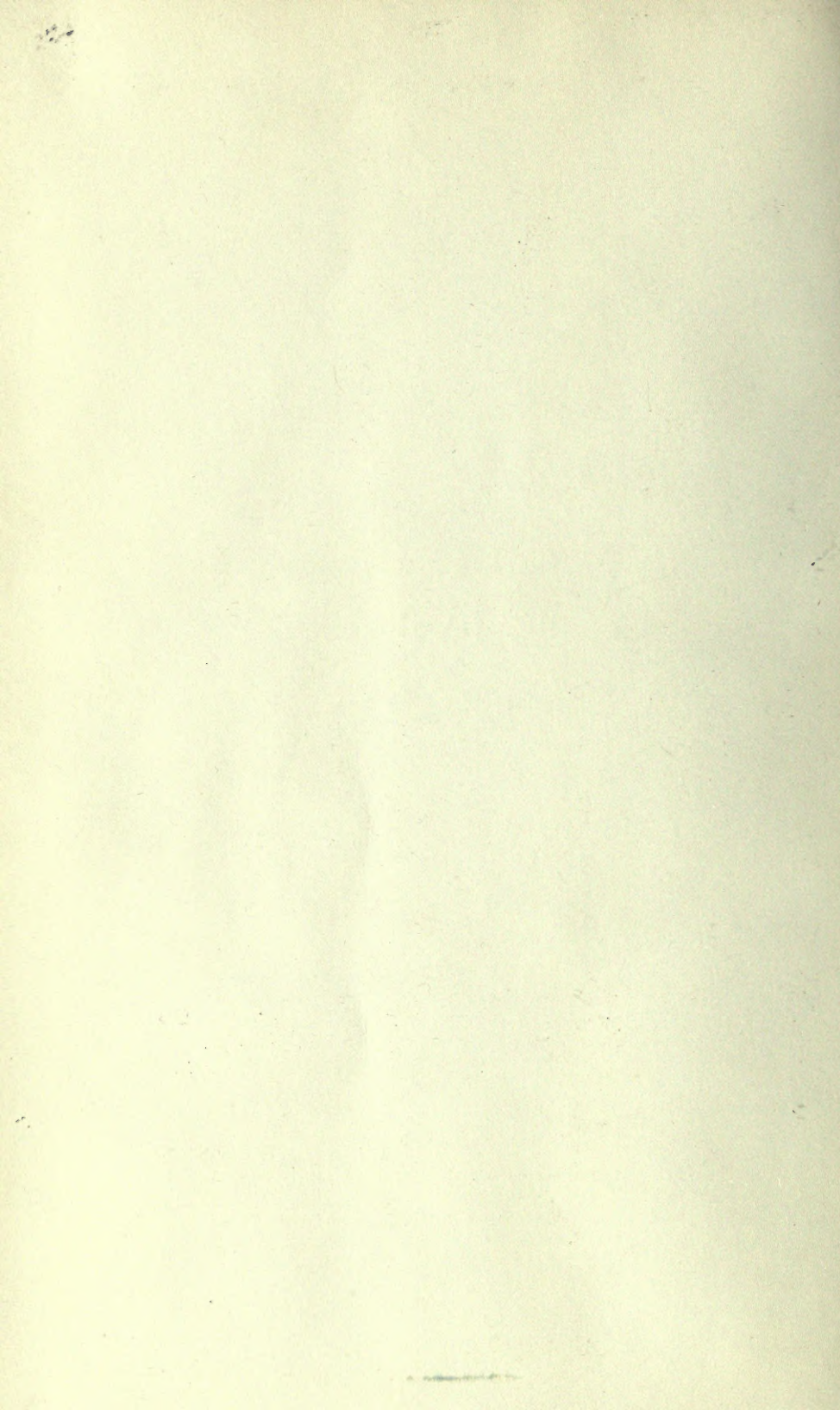


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